SEPTEMBER 1954

PIPE LINE INDUSTRY

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CONSTRUCTION • OPERATIONS • MAINTENANCE

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How Stresses Are Affected by Branch Connections

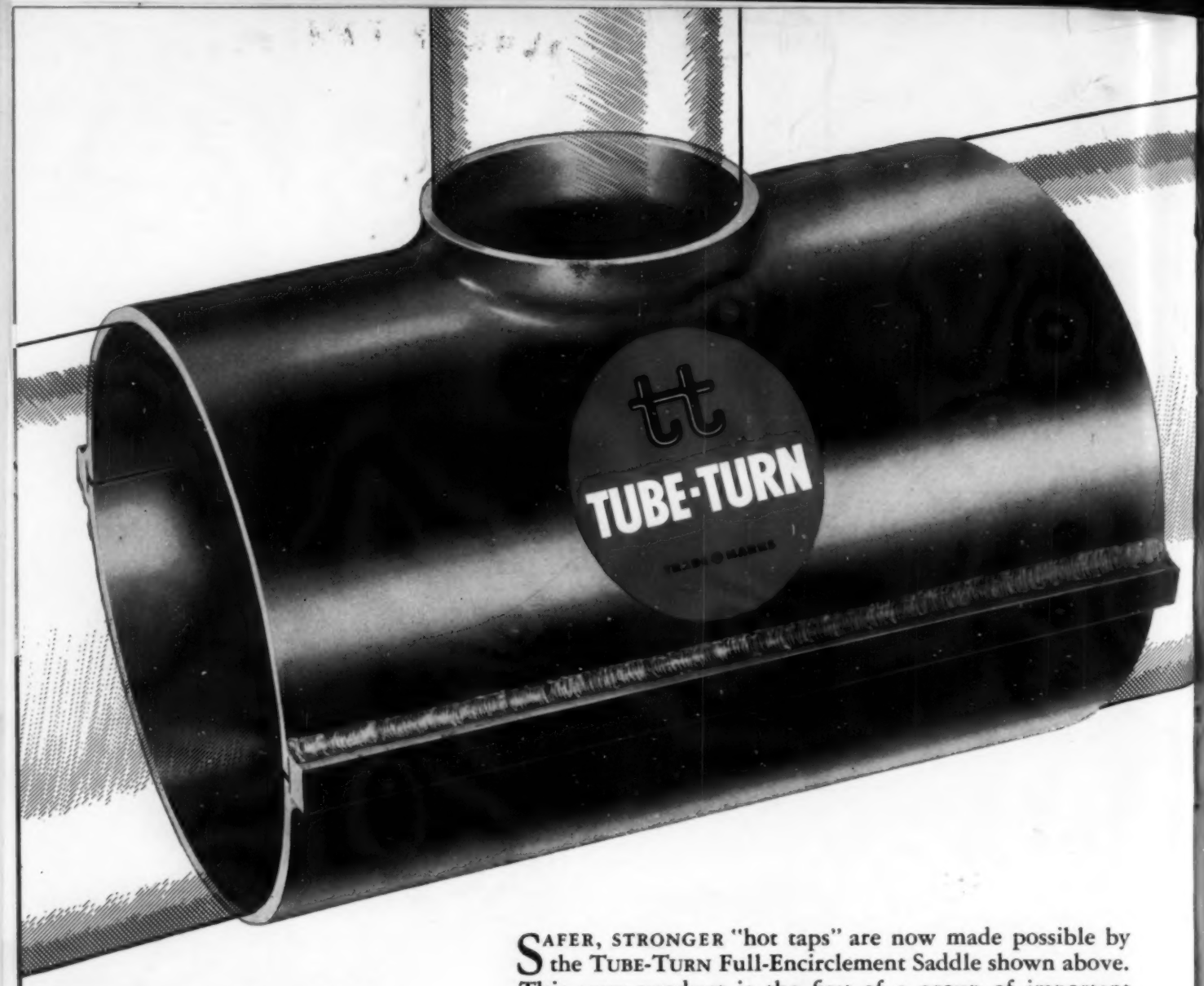
Don't miss this report of research on unreinforced branch connections. Learn what effect the findings will have on design of piping systems for gas transmission ..... Page 60

Communications Make the Manager

To succeed you must have facility in business correspondence, public speaking, technical writing. Here's how to achieve it ..... Page 40

Find Exhausting Time for Gas Line Blowdown

Here is a solution to the problem of determining valve size and exhausting time for blowdown of a gas system ..... Page 82



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TUBE-TURN Full-Encirclement Saddle improves "hot-tapping" of piping

SAFER, STRONGER "hot taps" are now made possible by the TUBE-TURN Full-Encirclement Saddle shown above. This new product is the first of a group of important developments of Tube Turns' unique pulsation pressure testing program.

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PIPE LINE INDUSTRY

CONTENTS and Quick Review

September, 1954 Vol. 1, No. 3

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

Communications Make the Manager

☐ Pipe line men must communicate if they are to succeed. In this article, you'll get some solid information on how to communicate. Read it unless you already know the answers to these questions. Are you a goozler? Are your ducks lined up? Is your English telegraphic?

By Robert W. Hays.....Page 40

Gas Supervisors Attend Management School

☐ A new kind of school for gas men, aimed at training them to do better jobs in present positions and to understand gas transmission company economic structure was held recently at Texas A. & I. College's campus.

Page 41

Heaviest Vessel on the Move

☐ When El Paso Natural engineers found no equipment capable of supporting the 324,000 pound dethanizer tower to be installed at the Midkiff, Texas, compressor station and gasoline plant, they designed and built an aethia wagon to do the job, probably one of the heaviest vessels ever hauled across country in a single piece.

Page 43

Maintaining Peak Efficiencies on Compressors

☐ Here's a presention of a compressor maintenance program designed to keep the units in good condition, reduce downtime to a minimum and hold maintenance and operating costs down.

By Errol R. Wagner.....Page 44

New Pipe-Laying Barge, "Dredge Booth"

☐ Pipe Line Industry sent a photographer to visit the "Dredge Booth" in the Gulf of Mexico. But the pictures he brought back weren't of dredging—because this dredge has never dredged. Instead it stovepipes pipe lines into the Gulf of Mexico.

Page 49

How Indicator Cards Spot Compressor Ills

☐ Here is a way to become an expert trouble shooter for compressor cylinders. Take periodic readings with a chromatic engine indicator, match the readings with the charts provided by the author and diagnose compressor ailments before they happen.

By Earl Y. Palmer.....Page 52

How Texas Gas Uses Photo Maps

☐ Texas Gas Transmission Corporation has 1200 miles of its system on photo maps. These maps, which combine aerial photography with usual alignment details, have saved this company money as well as engineering and drafting time.

By J. E. Thompson.....Page 54

How Stresses Are Affected by Branch Connections

☐ The stresses in branch connections on pipe lines have been the object of an extensive research program at Battelle Memorial Institute. Researchers who have been studying unreinforced branch connections, report on the findings which will have a great effect on design of piping systems for gas transmission.

By E. D. Abraham and G. M. McClure.....Page 60

Products Go Underground

☐ The amazing growth of underground storage prompted a check on this development. Economics is the answer to why this type storage has been expanded to the storage of jet fuels, gasoline, crude, chemicals and chemical charge stocks. This article tells how some companies are going about the construction.

By G. H. Billue.....Page 66

How to Save Steel Tanks

☐ Here's a discussion of cathodic protection for steel tanks and two general methods for reducing corrosion caused by electrolytic action. One is by insulating the metal surface through application of protective coating to the tank surface; another by applying cathodic protection current to the surface of submerged metal.

By Harry J. Keeling.....Page 68

Service Craftsmen Salvage a Cylinder

☐ Service Pipe Line Company saved $7000 when employes salvaged two broken cylinders for a simplex pump and made a new cylinder out of the parts. They simply cut the cylinders into two parts, machined them and bolted them together.

By Carl I. Huss.....Page 74

Corrosion Resistant Plastic Tanks Have Unprecedented Strength

☐ Plastic tanks are being used successfully in areas where sour crude oil poses serious storage problems. Highly resistant to corrosion, they are being designed for oil leases, pipe line tank farms and for refineries and petrochemical installations.

By Anthony Gibbon.....Page 78

Find Exhausting Time for Gas Line Blowdown

☐ You don't have to be an engineer to determine valve size and exhausting time for blowdown of a gas system. Here is a graphical solution to this otherwise difficult problem which gives highly accurate results.

By Tracy S. Park, Jr.....Page 82

Rules of Thumb for the Pipeliner's Notebook..... 76
You Asked About Corrosion.....*Marshall E. Parker* 80
Who's Meeting Where..... 94
How to Do It—Pipe Line Hints..... 96
What's Happening in Pipe Line Construction..... 104
PIPE LINE INDUSTRY's Views of the News..... 110
Pipe Line Men in the News..... 118
What's Happening Among Service and Supply Men..... 124
What's New in Equipment..... 130
ADVERTISERS' INDEX..... 136

Iranian Agreement Is Blow to Russia

The near settlement of the three-year-old Iranian oil controversy is a major historical event of the world. While sure to wield vast influence on the international petroleum situation, its real importance is the long-range effect on future world military and political affairs.

The agreement, now lacking only ratification by the Iranian Parliament, represents a bitter and significant defeat for Russia. It is an equally sweet and significant victory for the Free World and for private business enterprise. To a large degree, the settlement is the work of private business companies.

Iran's principal source of revenue has been restored, saving the country from bankruptcy. The income is expected to be used to develop irrigation projects and other rich natural resources of the country, thereby strengthening the country's stand against Communism.

Consequently, the settlement creates a new and formidable military and political buttress against the expansion of Communism in southern Asia. The chances of preventing at least a major portion of southern Asia from falling into the Soviet orbit have been enhanced many fold. A new foe against Communism has been established at a most strategic point.

•

The importance of the agreement from a military and political viewpoint is extremely significant because of Iran's location.

Russia's high hopes of Communistic sympathizers taking over the Iranian Government have been defeated. Since Iran extends from the Caspian Sea to the Persian Gulf, this would have successfully divided the whole of Asia. With the conquest of northern French Indo-China, this would have given the Soviets control of important areas at both the eastern and western edges of southern Asia, practically sealing off south central Asia. Furthermore, Soviet control of Iran also would have placed Communism deep in the very heart of the Middle East, within an easy stone's throw of all the area's great oil fields.

Now the situation is reversed. Instead of a major victory, the new situation presents dangerous military and political implications for the Soviets.

Iran lies immediately east of staunchly anti-Communist Turkey. Like Turkey, Iran has an extensive common boundary with Russia. Together, these two countries form a strategic 2000-mile long buttress against the Soviets.

The Soviets now have new serious problems to think about before taking any action that might lead to a full-scale shooting war with the West. The Caucasian oil fields, one of Russia's two important petroleum sources, lie only a short distance north of the Iranian border. Major Russian industrial centers now are within easy bomber range of a greatly expanded area. Many of Russia's great Ural Mountain industrial centers are but 1000 miles from the Iranian border. They are over 2000 miles from West Germany and France.

Now the Free World's boundary with southern Russia extends almost to the western edge of the great Himalayas, whose average elevation of 20,000 feet forms a near-impregnable topographical barrier to modern armies, extending from Afghanistan eastward across Asia as far as Burma.

•

Much of the credit for working out the Iranian oil controversy must go to Communism's arch foe—private business enterprise in the form of the oil industry.

Eight large oil companies have agreed to jointly operate Iran's oil fields and giant refinery at Abadan, and to also market Iran's oil abroad. The Iranian Government will receive half of the profits. Iran's production is expected to reach 300,000 barrels daily in 1955, rising to 450,000 in 1956 and 600,000 barrels per day in 1957.

The willingness of the oil companies to agree to this program in the face of the current surplus supply of petroleum is noteworthy. Iran's production was not needed. Return of Iran's oil to international markets will absorb much of the increase in world consumption during the next three years.

Therefore, it is to the eternal credit of private business that eight oil companies were willing to work out plans providing for settlement of the Iranian affair in a fair manner.

Warren L. Baker

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Alone on an Island

16 hours per day...

This "Oilwell" DGE-250 Two Stage Compressor Unit is designed to handle 1,090,000 cubic feet of gas per day with 250 input horsepower. Horizontal fan provides forced air flow vertically through radiator cores, so that prevailing winds do not affect cooling efficiencies.

. . . called for gas-handling equipment that could do the job by itself . . . that's why Mel Dar Corporation engineers selected this "Oilwell" Direct-Drive Compressor Unit for . . .

Boosting Gas into the Transmission Line

Some 17 Miles out in the gulf near Corpus Christi, Texas, a field of 155 producing wells is centered around a 160-acre island which gets drenched by mist and spray from every passing storm. Nobody lives there. The production men make daily trips from the mainland by launch. The rest of the time this installation operates unattended.

Because of their fully-enclosed weatherproof design, "Oilwell" DGE Compressor Units with direct drive between prime mover and compressors, meet the all-weather operating requirements of such isolated locations perfectly.

On this lease, all of the wells produce wet gas which comes from separators at approximately 30 psi and is compressed by this two-stage unit to approximately 760 psi. Following passage through an after-cooler and dehydrating unit, it is then mixed with dry gas from other wells and injected into Tennessee Gas Transmission Company lines for transmission to northeastern markets.

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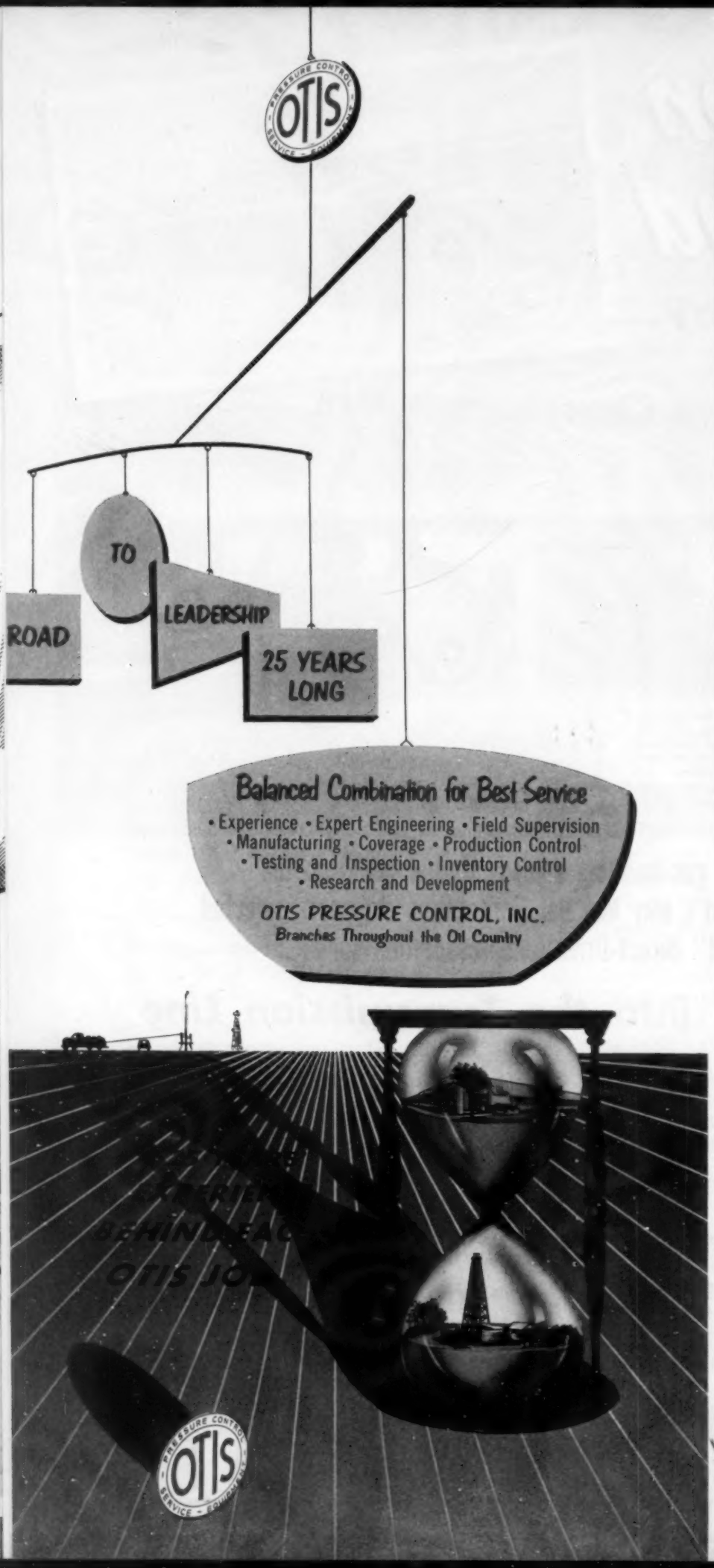

PIPE LINE INDUSTRY

Specialized oil publications of **THE GULF PUBLISHING COMPANY**, 3301 Buffalo Drive, Houston 6, Texas; Box 2608, Houston 1, Texas.

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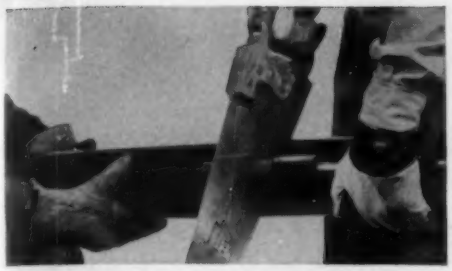

1 With an ordinary hand saw, cut the pipe to whatever length you need, right on the spot.

2 Clean the outside of the pipe and the inside of the plastic fitting. Fittings are available from Republic.

3 Using a standard paint brush, coat the inside of the fittings and the outside of the pipe with thinner.

4 Use same brush to apply welding solution to male end of pipe. Apply solution to within ¼" but not closer than ⅛" from end of pipe. This prevents internal bead from forming.

5 Stab pipe in fitting, give one-eighth turn, and the job is finished. This method of joining speeds new lines as well as replacements.

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...THE NEW EASY WAY

Your next oil field pipe line installation will be unusually easy if you use Republic Semi-Rigid Plastic Pipe. One reason: it's lightweight—3" pipe weighs only 13 lbs. per 20-foot length. Truck loading and unloading are simplified. Field assembly is speeded up. One man can easily carry several lengths at once. Even ditch a whole string by himself.

Joints are easy to weld, too, right on the spot. Tools? Ordinary hand saw and paint brush. Just follow the five simple steps illustrated at the left. When connection to steel pipe is necessary, a special flange adapter is provided.

Another big advantage: Republic Semi-Rigid Plastic Pipe, made of butyrate, is highly resistant to corrosive elements in petroleum products. Its smooth walls resist paraffin-clogging. This means long life, minimum maintenance.

Semi-Rigid comes in 20- and 40-foot straight lengths, in 9 sizes from ½" through 6". In coils, ½", ¾" and 1" diameters are available. It is normally supplied in black. Clear pipe is available on request. Remember: Republic Semi-Rigid Plastic Pipe is made by pipe men—men who know your piping problems. For complete information, send for Booklet No. 603.

NEW FREE BOOKLET No. 603 gives sizes, lengths, test pressures and other valuable information on Republic's New Semi-Rigid and Flexible Plastic Pipe. Write for it.

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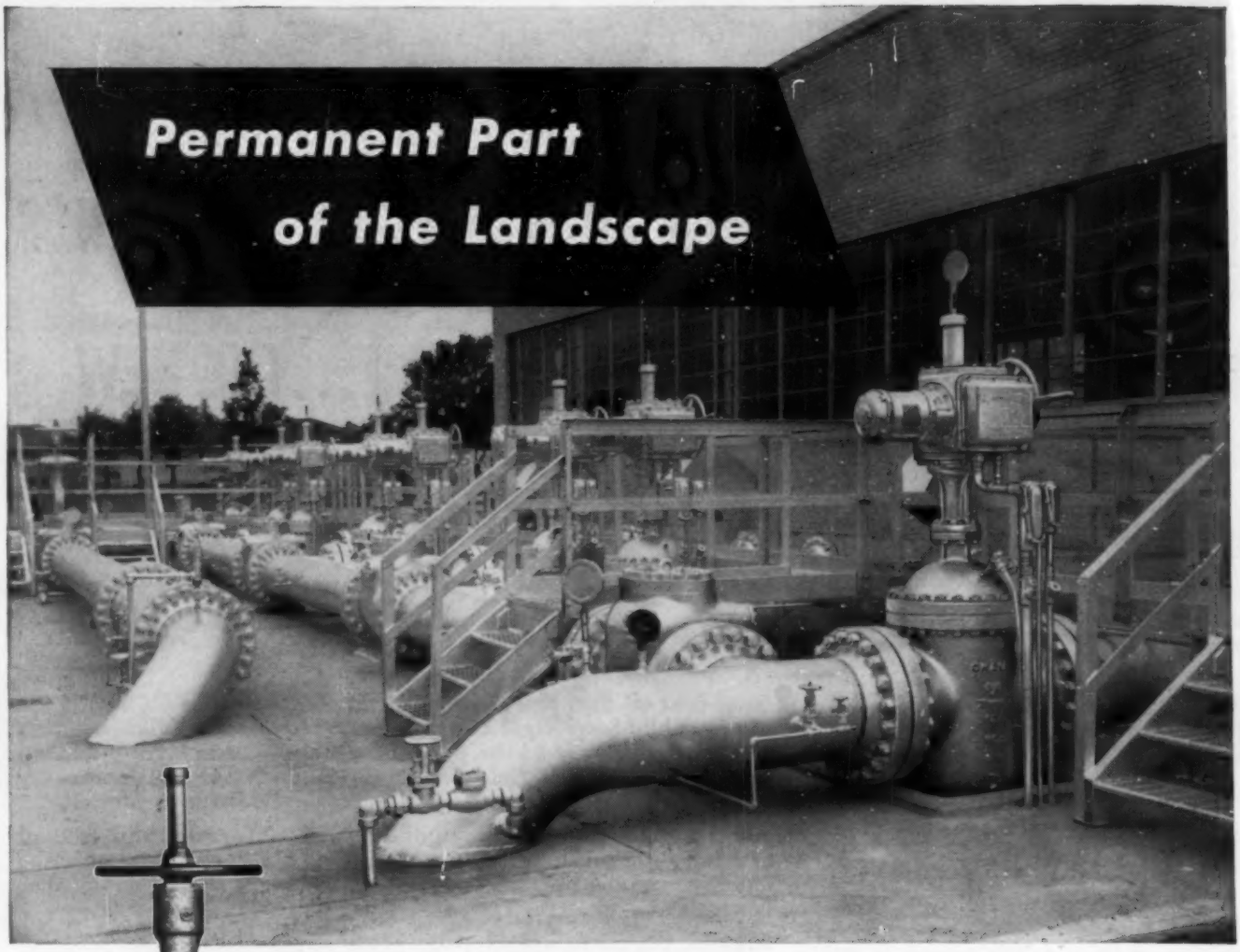

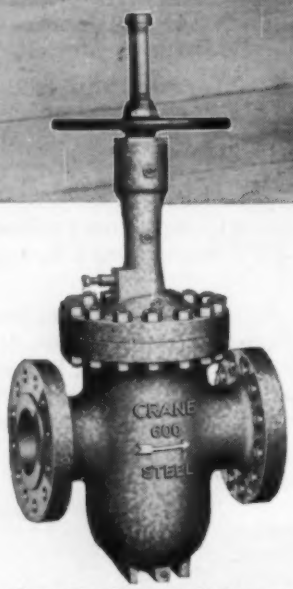

Crane Pipe Line Gate Valves are made in Full-Way or Venturi patterns for working pressures up to 1440 pounds, oil or gas. Sizes 2 to 30 inch.

Dependable CRANE pipe line valves

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And to assure smooth, clear flow with minimum pressure drop, Crane designed the conduit-type disc ports to coincide exactly with the seat openings. There are no pockets to catch dirt or cause turbulence. Read all about this pipe line favorite in your Crane 53 Catalog and in Circular AD-1864 available from your Crane representative, or write direct.

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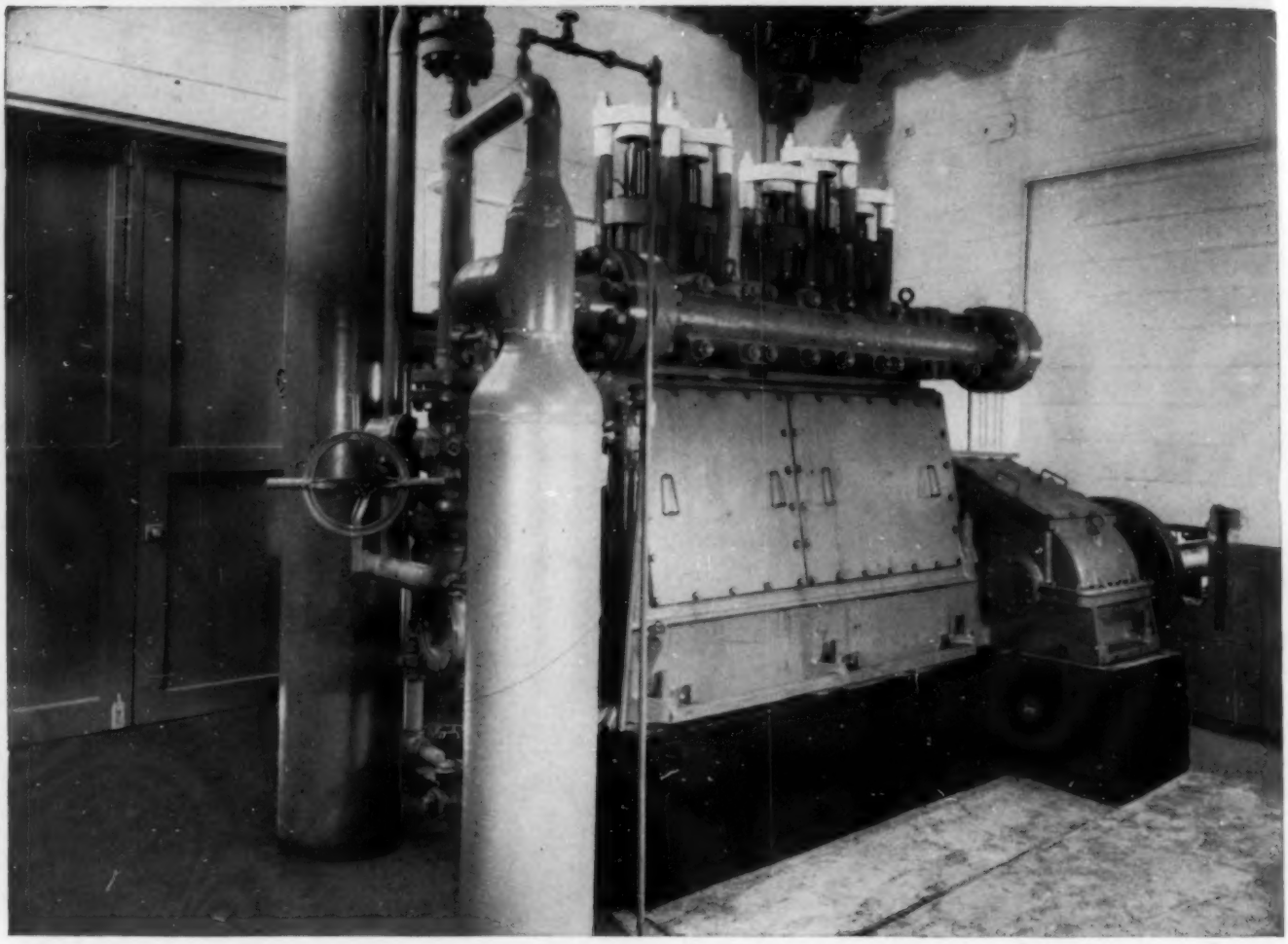
A WORD TO THE WISE— STANDARDIZE!



ALDRICH PUMPS Send Liquids Through Cross-Country Pipe Line

In service at the North Salt Lake Pumping Station of the Salt Lake Pipe Line Company, this Aldrich Quintuplex Inverted Direct Flow Pump and a twin unit are used to pump liquid products through an 8″ pipe line to Boise, Idaho, some 350 miles distant.

Fluids sent on their long distance journey by these Aldrich Pumps include regular and premium automotive gasolines, Diesel fuels, stove oils and alkyate. Pumps feed 375 gpm, against maximum discharge pressure of 1700 psi. Suction pressure averages 30 to 40 psi. Installed in December 1952, these pumps already have been in operation more than 2000 hours each.

This operating performance story is typical of Aldrich's record throughout the oil industry. In whatever way they're called upon to serve—whether water flooding, lean oil service, salt water disposal, crude and gathering lines, product lines, bottom hole pump service, or pumping liquid hydrocarbons—Aldrich Pumps set standards for dependable operation.

With Aldrich Pumps the user gets several marked construction advantages and benefits. For example, fluid ends are sectionalized, so that parts can be replaced quickly and at low cost. Plunger sizes are changeable, and wearing parts are interchangeable among pumps of the same stroke sizes. And ample stocks of spare parts are maintained at Mid-Continent and California locations.

Aldrich Direct Flow units are available in 3″, 5″ and 6″ stroke sizes, with 3, 5, 7, or 9 plungers . . . range from 10 to 2400 hp. Pressures are available to meet requirements (up to 15,000 psi or higher).

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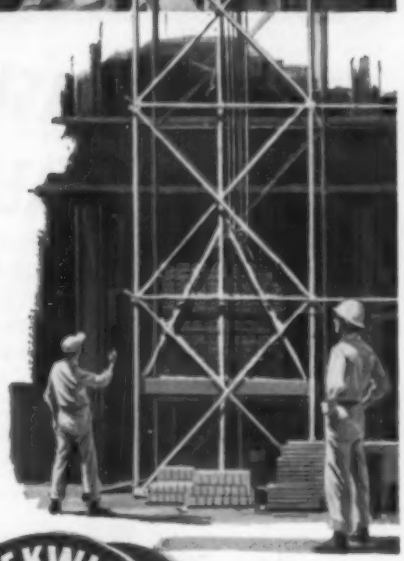

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who are tired of doing it the hard way

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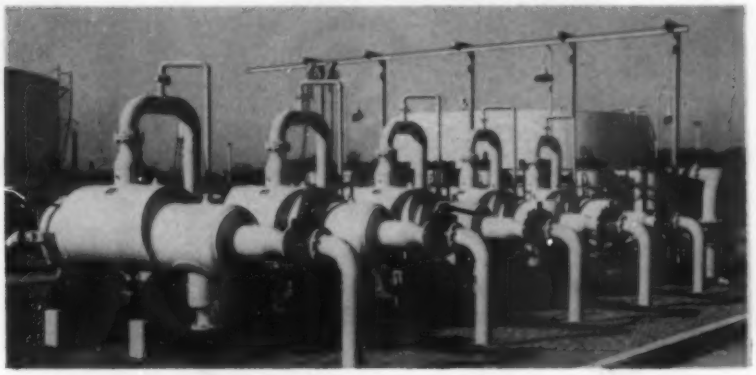

An installation of five, 30,000 bbl. capacity, Jet Type Self-Cleaning Fluid Strainers on one of the largest U. S. products pipe lines.

tomary to bypass the stream . . . or just let the strainer elements blind and burst . . . and the meters took the rap.

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Installations of Jet Type Self-Cleaning Fluid Strainers have proved beyond doubt their sound design and entirely satisfactory performance.

Interested pipe line operators are invited to write for complete details.

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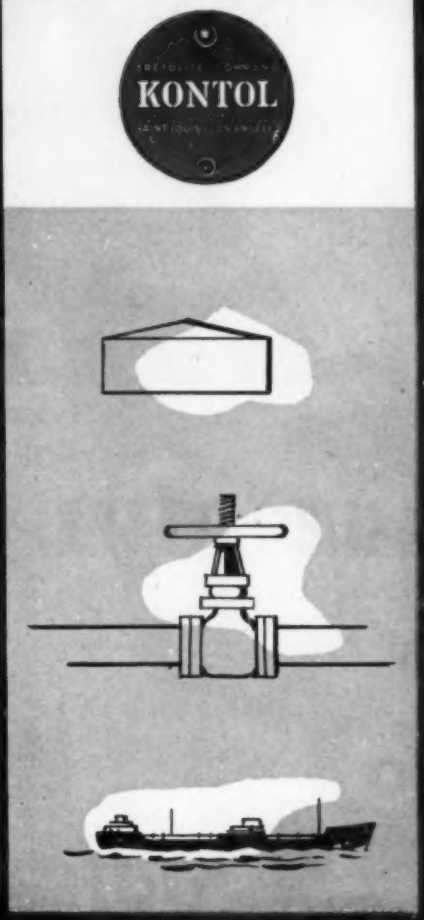
Kontol 77 effectively prevents rusting caused by the presence of oxygen in finished petroleum products. It has no harmful effect on the product quality. It does not affect color, octane number, accelerated gum, precipitated lead or other av-gas specifications.



For complete information, call your Tretolite man or write to:

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For more data on advertised products, use Readers' Service Cards, last page.

At a cost comparable to conventional compressor piping - you can install a GUARANTEED Fluor Pulsation Dampener Piping System*

On new construction we can fabricate and install a complete Fluor Pulsation Dampening Piping System that prevents compressor pipe vibration, at a price almost identical with that of a normal system of conventional piping.

How can we do it? Because we've been in the pipe dampening business a long time. We pioneered the use of piping systems based on scientific acoustical principles applied to fluid flow. We've learned from experience: since 1943 we've put into service 351 Fluor dampening installations throughout the world. We know that when we install a system we can guarantee it without equivocation. In plain words, we know our business.

To save time and costs on these jobs, Fluor maintains two well-equipped pipe fabricating shops—one at Los Angeles and one at Paola, Kansas. Fluor has perfected streamlined techniques for designing and building dampening systems—has the volume production to cut manufacturing costs—possesses the necessary experience to offer a better integrated unit at a price comparable with any normal system.

In addition to getting an economical "packaged" piping system free from vibration, you get many plus advantages in a Fluor designed system: more accurate flow measurement, lower maintenance costs, greater safety to personnel and elimination of vibrational stress on heat exchangers, vessels and related equipment. If the cost of a Fluor dampening piping system is measured by these advantages, then it is certainly one of the most economical buys in compressor plant equipment, today.

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For information on Fluor Pulsation Dampener Piping Systems, write for Bulletin PDS-8501-R.

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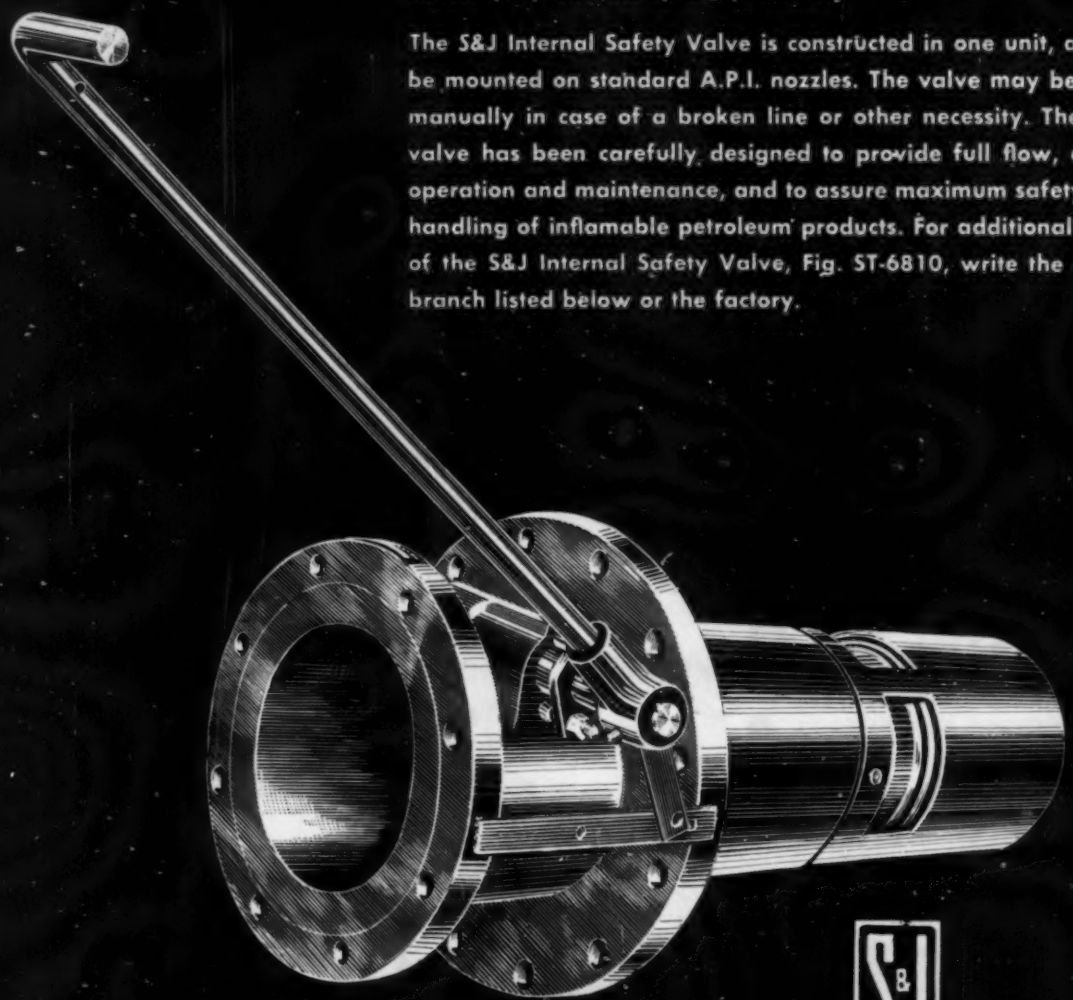
The S&J Internal Safety Valve is constructed in one unit, and can be mounted on standard A.P.I. nozzles. The valve may be closed manually in case of a broken line or other necessity. The entire valve has been carefully designed to provide full flow, ease of operation and maintenance, and to assure maximum safety in the handling of inflamable petroleum products. For additional details of the S&J Internal Safety Valve, Fig. ST-6810, write the nearest branch listed below or the factory.



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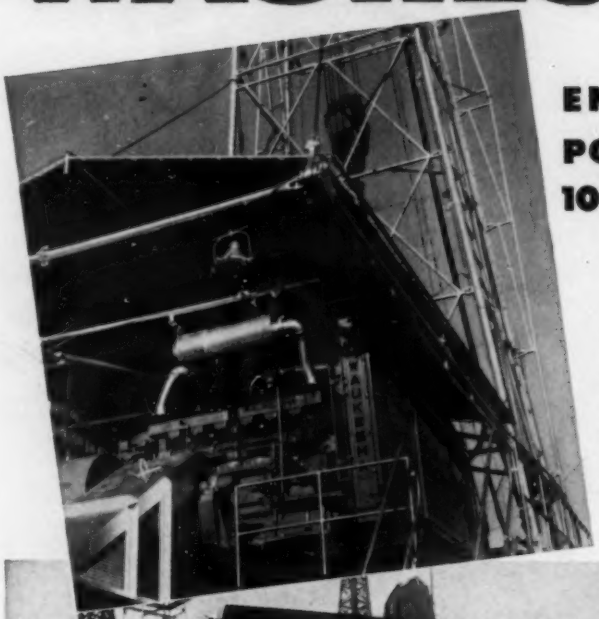

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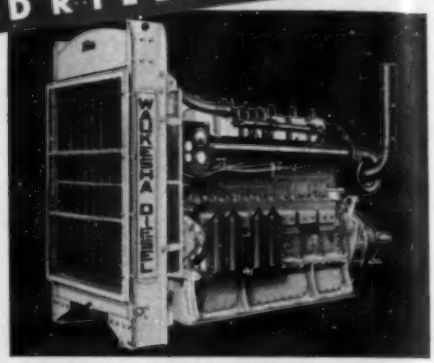
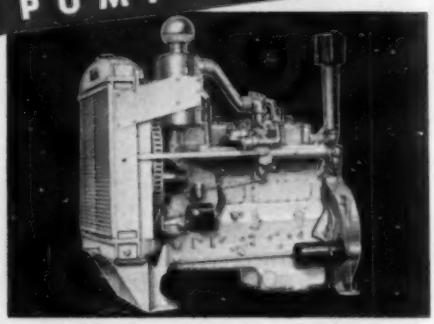
DRILLING



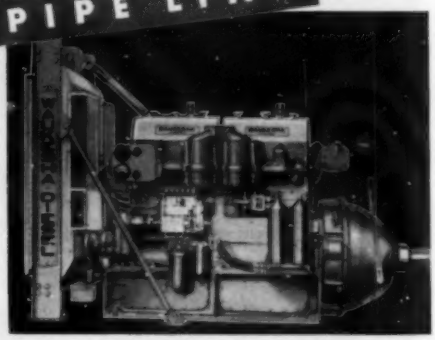
LRDBSU Turbocharged Diesel Unit—six cylinders, 8½-in. bore x 8½-in. stroke, 2894 cu. in. displacement, 526 hp at 1200 rpm, maximum.

PUMPING



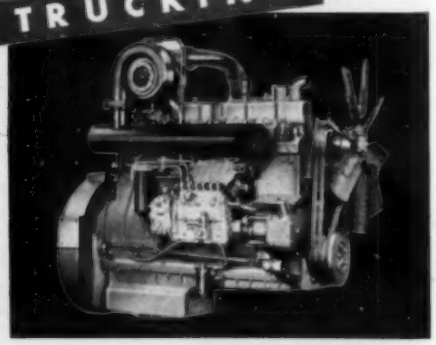
145-GZBU Gas Power Unit—six cylinders, 5⅜-in. bore x 6-in. stroke, 817 cu. in. displacement, 176 hp at 2000 rpm on natural gas.

PIPE LINE

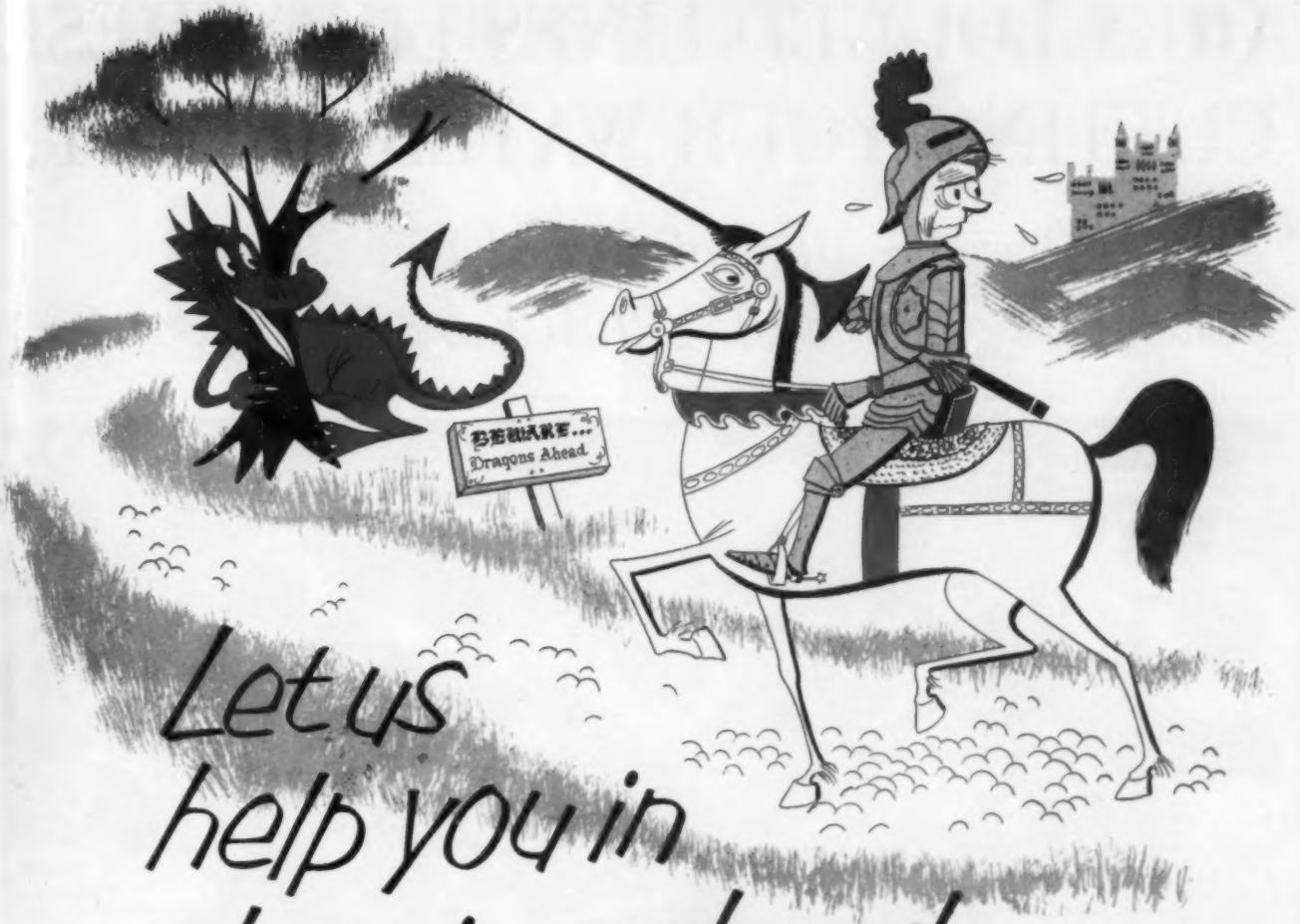


NKDBU Normal Diesel Power Unit—six cylinders, 7-in. bore x 8¼-in. stroke, 1905 cu. in. displacement, 274 hp at 1200 rpm, maximum.

TRUCKING



148-DKBS Turbocharged Truck Diesel—six cylinders, 5¼-in. bore x 6-in. stroke, 779 cu. in. displacement, 280 hp at 2100 rpm.



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For more data on advertised products, use Readers' Service Cards, last page.

ARE CLOGGED LINES LIKE THESE CUTTING YOUR WATER SUPPLY?

Over 1½ Miles of Buried Water Line Chemically Cleaned IN PLACE by Dowell Service

You don't have to dig up water lines in order to clean them! Take the case of a major railroad that had over 8600 feet of *buried* water lines, ranging from 2 to 12 inches in diameter. The capacity of these lines had been greatly reduced by scale deposits. Dowell Service used liquid solvents to clean all the lines, *in place*, during a period of only six days with a minimum interruption in service.

Dowell Service offers *fast*, effective chemical cleaning of pipelines of all kinds—water lines, disposal lines and product lines. And, whether these lines are underground or above, indoors or out, no digging or dismantling is necessary. Dowell solvents are designed to dissolve the accumulated deposits, and are introduced through regular connections. Because they are liquid, Dowell solvents reach wherever steam or water can flow, cleaning places inaccessible by other methods—angles, curves, valves, complicated surfaces and hook-ups. *Experienced* Dowell engineers do the job using Dowell-designed truck-mounted pumps, mixers and control equipment.

Many other types of equipment can also be cleaned chemically by Dowell. If you have boilers, condensers, evaporators, bubble towers, water wells or other operating equipment where deposits are reducing capacity, let Dowell Service *save you time and money in maintenance cleaning!*

FIND OUT ABOUT CHEMICAL CLEANING! There are many places in your plant where Dowell Service can clean equipment faster and better than out-dated mechanical methods. Call your nearest Dowell office for a fact-filled book. Or write direct to Tulsa, Dept I-59.

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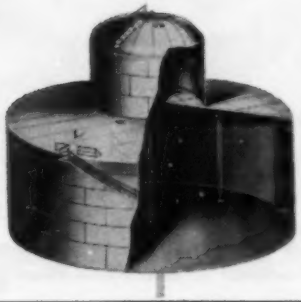


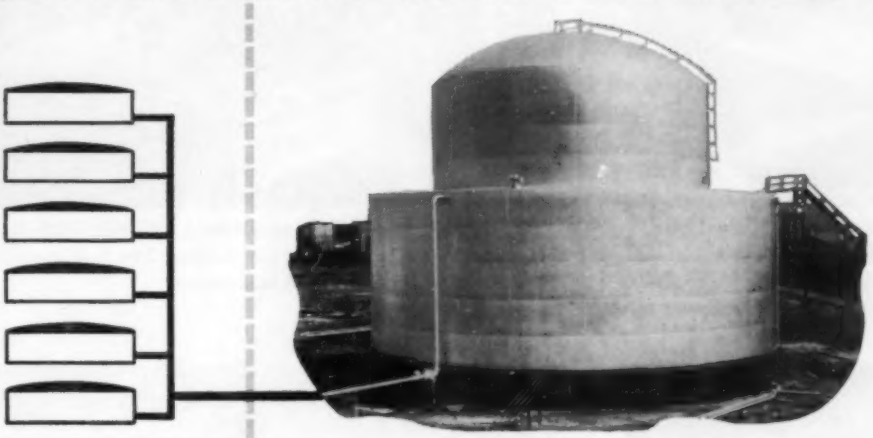
MONEY SAVER FOR PRODUCT-STORAGE OPERATORS!

The Hammond DIALIFT is the modern tank for eliminating breathing losses and reducing filling losses. It gives maximum conservation of vapors at lowest cost.

42'6" x 40' Liquid Storage Tank
22' x 17'9" Dialift. Housing — 6500 cu. ft. capacity Inter connected to a 25' x 40' Cone Roof Tank

50' x 48' Liquid Storage Tank
30' x 15'9" Dialift. Housing — 12,500 cu. ft. capacity

The DIALIFT consists of a tubular membrane attached gas-tight to the inside periphery of a cylindrical housing. In operation the DIALIFT functions as the lung of the storage tank. The membrane lifts under a slight pressure when additional vapor storage space is needed, and lowers when less vapor space is required; self-adjusting to the constantly changing breathing conditions within the tank.



80' x 30' Liquid Storage Tank
35' x 17'9" Dialift. Housing — 20,000 cu. ft. capacity

It is easy to convert an existing Cone Roof Tank to an efficient DIALIFT installation. A DIALIFT housing is superimposed on the existing roof, breather holes are installed through the roof plating permitting a free passage for all vapors, no other preparation is necessary.

60' x 48' Ground Type Dialift. 150,000 cu. ft. capacity

*patented

Bulletin 53DL details and describes the Hammond Dialift . . . Write for your copy.

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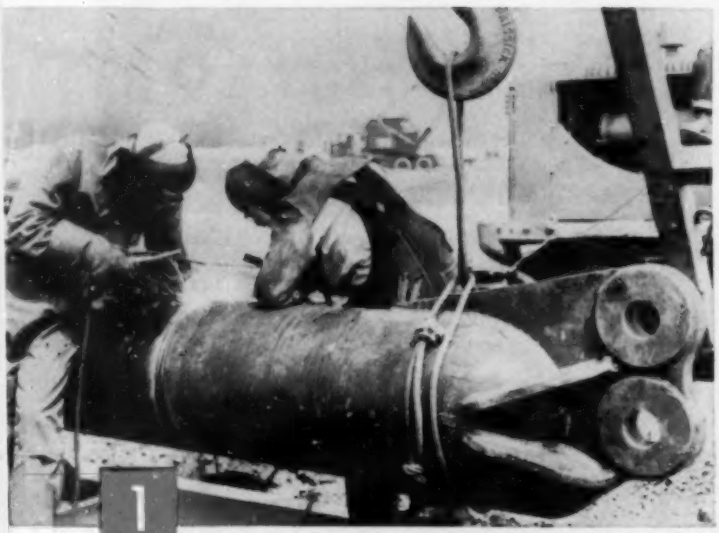
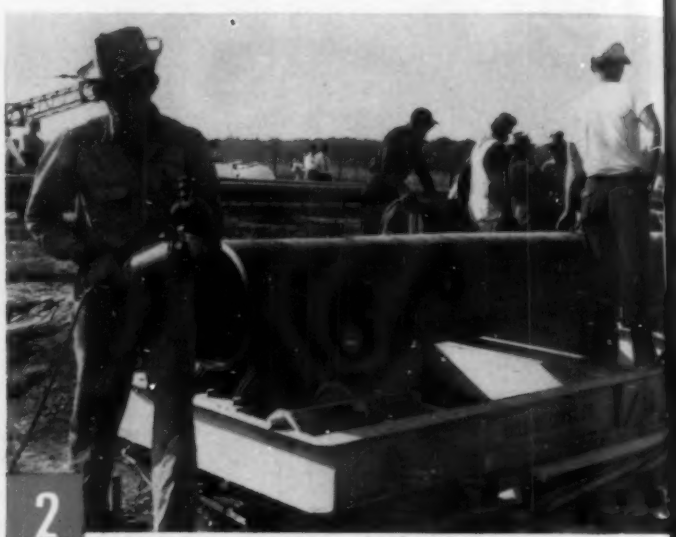


1

"OLD BULLHEAD," the watertight pulling dome, being welded to the first length of pipe. The 4-mile pipeline was pulled across the Straits by a powerful winch which was set in a concrete foundation approximately 2,700 feet from the water's edge on the Mackinaw City side.



2

A SECTION of the extra-heavy $13/16$-inch wall National Seamless Pipe being prepared for welding. The pipe is resting on one of the Collins rubber-tired launchways.

3

THE FIRST SECTION of pipe ready for launching at St. Ignace, Michigan. On the water, in the background, is a dredge which assisted in the pulling operation. At the left is the Control Tower, nerve center of all operations during the "Big Pull."

4

MAKING A TIE-IN WELD between two of the 2500-foot sections of National Seamless. As each section was launched, a new section was welded to it, until all eight 2500-foot sections had been welded into one continuous 20,000-foot line of National Pipe.

"BIG PULL"

submarine pipeline crossing

SOUND planning, a world of technical know-how, and the utmost care in selection of materials made possible the "Big Pull"—Lakehead Pipe Line Company's two 20-inch crossings of the 4-mile wide, 250-foot-deep Straits of Mackinac—the deepest and longest submarine lines ever laid.

Ingenious systems and devices had to be created for dredging, launching the pipe, adding buoyancy, pulling the pipe, filling it, and releasing the pontoons after the pipe was laid. Bad weather and rough water had to be overcome. The work, both ashore and afloat, had to be closely synchronized via a radio-telephone network, providing constant two-way communication as the pull progressed. And, of utmost importance, the pipe used had to have the unusual combination of high strength, extreme flexibility and maximum uniformity. It had to resist great pressures, absorb distorting and bending stresses; it had to have superior welding qualities; and for years to come it will have to be "trouble-free"—completely dependable. National Seamless Steel Pipe met these requirements and was the ultimate choice.

Twenty-seven foot lengths of 20-inch OD National Seamless Pipe, $^{13}/_{16}$-inch wall, were welded into eight sections, each approximately 2,500 feet long and weighing 220 tons. The pipe was coated and wrapped with two layers of fibre glass matting, and the lower perimeter was sheathed with timber lagging to protect it from possible damage as it scraped the bottom of the Straits.

The first of the two 4-mile sections of pipe was pulled across the Straits in just less than seven days. The second crossing was accomplished in only 65 hours and 5 minutes. Bechtel Corporation of San Francisco, California, as the agent for the Lakehead Pipe Line Company, Inc., managed the history-making crossing, which was completed by Merritt-Chapman & Scott Corporation, general marine contractors; and Collins Construction Co. of Victoria, Texas, submarine pipeline specialists.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION
PITTSBURGH, PA.
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

5 **STRAPPING FLOAT** to section of 20-inch pipe being pulled across the Straits. Floats were placed at 66-foot intervals to prevent heavy pipe from dragging on the bottom. With floats attached, pipe had a negative buoyancy of six pounds per foot.

6 **"OLD BULLHEAD,"** just after it emerged from the water at the south shore (Mackinaw City) landing site. It was greeted with triumphant shouts and a champagne christening by executives and employees involved in the operation.

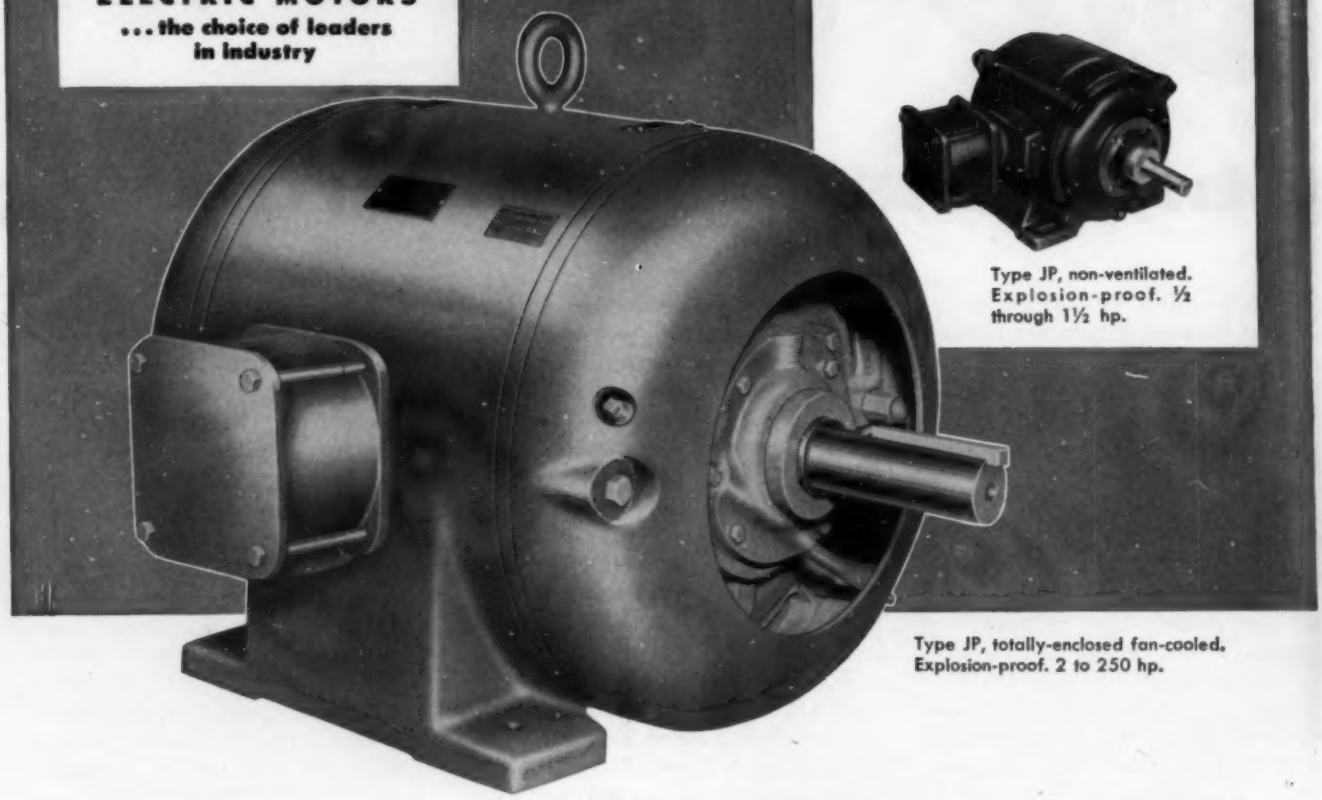
USS NATIONAL SEAMLESS PIPE AND TUBES

USS

UNITED STATES STEEL

Wagner®
ELECTRIC MOTORS
... the choice of leaders in industry

Type JP, non-ventilated. Explosion-proof. ½ through 1½ hp.



Type JP, totally-enclosed fan-cooled. Explosion-proof. 2 to 250 hp.

for extra protection against corrosion

SPECIFY **Wagner** *CAST IRON FRAME MOTORS*

Here are stock motors specifically designed for use in chemical plants, oil fields, refineries, steel mills—for rugged industrial applications where dust, dirt, moisture, or corrosive vapors are present.

These motors are totally-enclosed in corrosion-resistant cast iron and all parts exposed to the atmosphere are of corrosion-resistant material—including the nameplate. They feature completely protected laminations . . . special varnish treated windings . . . and a running shaft seal.

Wagner Cast Iron Frame Motors are available in fan-cooled standard and explosion-proof types in ratings from 2 to 250 hp, and in non-ventilated standard and explosion-proof types in ratings from ½ through 1½ hp. Wagner Bulletin MU-132 gives complete information.

A skilled Wagner engineer can help you select a Wagner Motor to meet your most exacting specifications. Call the nearest of our 32 branch offices, or write us.

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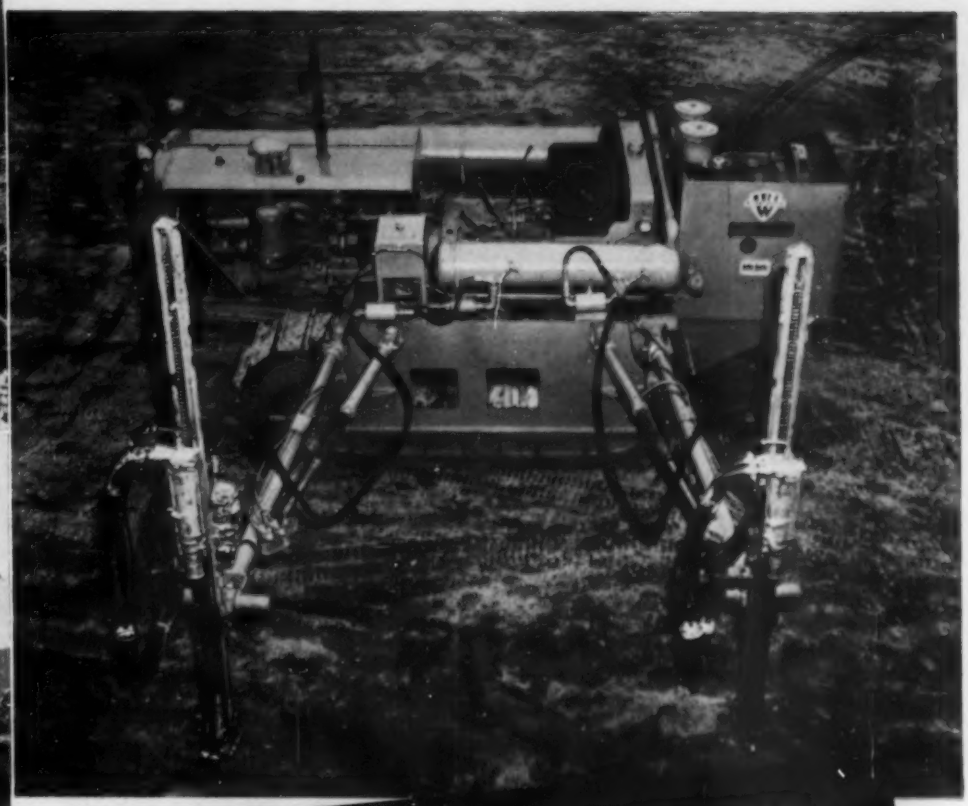

THIS JOY HYDROJIB PIPELINE DRILLING RIG is out-drilling everything else on the job By Over 33%!

HERE'S WHY... The Joy Hydrojib is self-propelled and self-contained. It even has its own 125-h.p. Joy WL-80 Compressor and Air Receivers. 3½" drifter-type drills with LW-6A chain feeds are mounted on Joy Hydro Drill Jibs. The 6 ft. feed-travel will bottom most ditch or right-of-way holes with one steel.

Hydraulic control of jibs and remote control of drills takes the heavy labor out of the drilling job. It isn't necessary, either, to jockey the tractor back and forth to get the drills positioned. The Hydro Drill Jibs will cover a width of 26 ft. and will extend to 10½ ft. from the side of the tractor.

The Joy Hydrojib does more work than several hand-held drills or wagon drills—and does it easier and in less time. ● Want more details? Get in touch with us: ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

W&D C 4725

JOY

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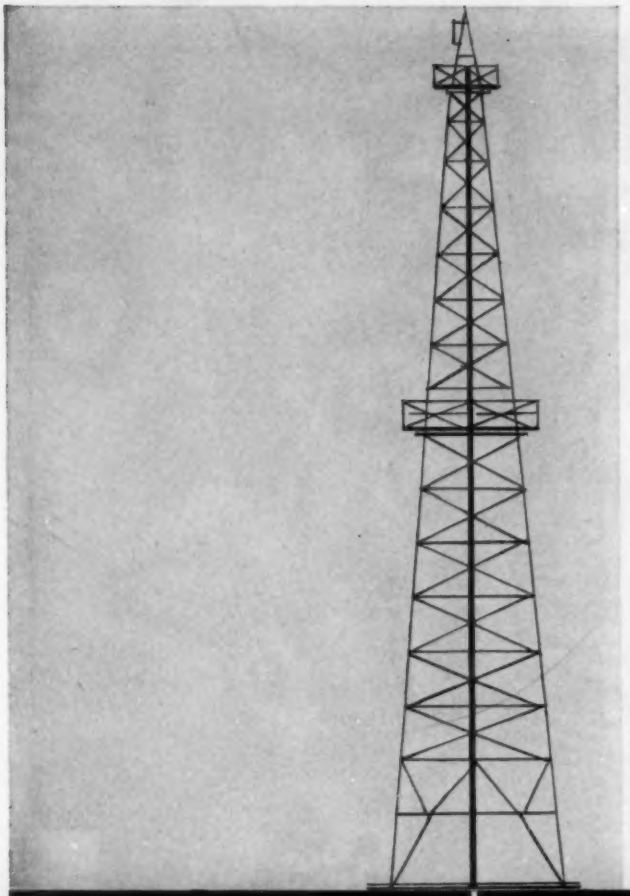
Ask for Bulletin No. M-214



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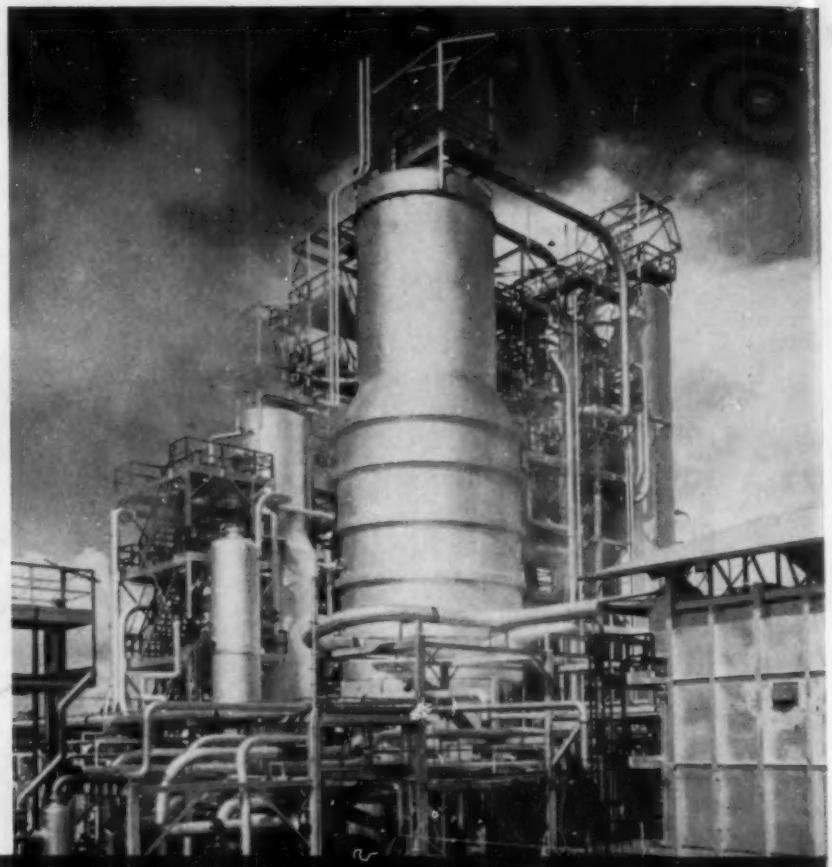
EC&M Bulletin 1062 Type ZHS 2300-volt Motor Starter in Type VIII enclosure for Class I, Group D hazardous atmospheric locations.



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Write for Booklet 1062 describing EC&M 2200-5000-volt motor starters

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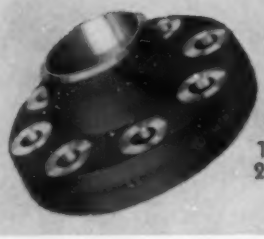

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Electric Resistance and Fusion Weld—Plain End	14" to 18" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser
Electric Resistance Weld—Plain End	5⅝" to 12¾" O.D.	Up to 55'	.188" to .375"	Fontana, Calif.
Electric Fusion Weld—Expanded—Plain End	20" to 30" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser

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Communications Make the Manager

The successful executive spends most of his time communicating. He needs facility in business correspondence, public speaking, and technical writing.

ROBERT W. HAYS, Assistant Professor,
Southern Technical Institute,
Chamblee, Ga.

THE SUCCESSFUL executive spends most of his time communicating his ideas to others.

Skill in communicating, then, is almost as important in industry as are technical and managerial skill.

Business Correspondence

Alert industrialists and businessmen have freed themselves from the trite, wasteful, bewhiskered old expressions dictated in business correspondence a generation ago. Instead of clinging to time-worn, retreaded expressions such as "I am in receipt of yours of the 29 inst . . .," the alert dictator remembers the first maxim of effective letter writing: a letter worth the approximately 50 cents it costs must win the reader's favorable attention. It must avoid the trip to the "circular file."

An application of practical psychology has made warmth and personality the most arresting characteristics of the modern business letter. The businessman should adopt the proper mental attitude as he begins to dictate. The alert dictator recognizes that first, his reader is an egotist who may have slight interest in the letter or in its author. Therefore, the most important pronoun in writing effective letters—letters that get results—must always be "YOU." In fact, a businessman may adopt this rule-of-thumb to test the effectiveness of his letters: "I," "we," or the name of the writer's company should not appear as often as the word "you" or the receiver's name. For if the letter contains a preponderance of "I's," it will probably not interest the reader.

"Take the other person's point of view" is an axiom surely practiced by successful salesmen; furthermore, this axiom involves much more than simply counting pronouns. For even a letter which passes the above-mentioned rule-of-thumb may not reflect genuine concern for the other person's point of view. This rule of thumb is no more than a minimum standard.

This proper mental attitude should be a question: "What does the reader of this letter need that I want to supply?" Or, before writing an adjustment letter or a claim letter, the businessman should ask himself: "What does the reader expect, and how will what I intend to say affect him?" Unfortunately, too many businessmen, recognizing that there is nothing new about this approach, scoff at such questions. Such an approach seems too "pat." Yet most business people can remember letters from friendly executives who in writing business letters forgot the most elementary principles of human relations.

The effective letter then, must display warmth, friendliness, and consideration for the reader's personality. It should follow the principles of personal conversation.

Format Important—Probably the next most important feature should be the form, format, and paragraphing of a letter. Here, the businessman must depend upon his secretary's cooperation. Certainly, the executive must emphasize to his secretary that a letter is a salesman: As the company putting its best foot in the customer's door, the letter must always present a neat, balanced appearance. Business executives who complain that their secretaries do not know how to transcribe a letter should understand that first, secretaries usually learn in business schools several obsolete letter forms as well as the modern block form, and that second, every executive has the same responsibility to his secretary as to his other employes. He must let her know the quality of work he expects her to produce, or he will not get the quality of work he wants.

Unless the executive dictates his own paragraphing, he should remind his secretary that readers of letters, like readers of advertising, appreciate "white space." Hence, a paragraph in a letter should usually be shorter than a typical paragraph in this magazine, in a text book, or even in a news story. The opening paragraph especially should be short and concise; if possible, it should give the reader a thumbnail sketch of what the letter concerns.

The secretary should also learn, if she does not already know, how to center the letter on the effective page (the page excluding the letterhead and any printed matter at the foot of the stationery). Usually, the left margin should be about 18 elite typewriter spaces wide (about 1½ inches), and the average right margin about the same. However, if the secretary has a typewriter which permits justifying the right margin—making all the lines come out flush—the right and left margins should be about equal.

Keep It Short—Finally, the executive should eliminate unnecessary wordage and wherever possible limit his letters to one page. Often, he can save space by preparing a rough outline of what the letter will contain *before he begins to dictate.* At least, outlining will usually accomplish two objectives: eliminating extraneous ideas and forcing the dictator to present his thoughts more concisely.

Concise writing is extremely important in preparing business letters. Far too many executives think about what they will say only after they begin to dictate. "Goozling," using the old stereotyped expressions of Victorian correspondence, usually results. For example, a goozling mind would produce the following paragraph:

> I am in receipt of yours of the 16 inst., and I beg to inform you that

Continued on Page 84

IN CLASS on gas economics, participants in the SGA Management Development program hear a lecture by Dr. Joe E. Brown, chairman of the department of economics at Texas A & I.

Gas Supervisors Attend Management School

SGA's course at Kingsville, Texas, teaches managers everything from load building to transmission company economics.

THERE ARE HUNDREDS of schools aimed at training men for advancement, but at last there is a course designed to train men to do better jobs in their present positions. The Southern Gas Associations' first two-week Management Development program was held in August at Texas College of Arts and Industries.

Twenty-nine natural gas company management men, representing 20 companies in 10 states, attended the course August 1-13 in Kingsville. Objective of the course was to give participants a better understanding of the fundamentals of management in the natural gas industry.

Curtis M. Smith, vice president of Tennessee Gas Transmission Company, was chairman of the SGA Management Development Committee which planned the course. Dr. Frank Dotterweich, director of the Division of Engineering at Texas A. & I., was director of the program.

Other members of the committee were Kenneth Fellows, Houston Natural Gas Company; Ray A. Metzke, United Gas Corporation; H. N. Oldham, Southern Union Gas Company; Tom Sterling, Oklahoma Natural Gas Company; Don W. Weir, Arkansas Louisiana Gas Company, and R. R. Suttle, managing director of SGA.

Classes and discussion periods were conducted by supervisors and lecturers who are authorities in their fields. In evening seminars, program participants exchanged ideas and information under the direction of a staff member.

On August 4 the group heard a lecture on the King Ranch, followed by a field trip to the ranch. On August 7 and 8 a tour of South Texas and the Rio Grande Valley was made to inspect cycling, gasoline and carbon black plants, natural gas transmission lines, dehydration plants, and drilling operations. The chemical plant of the Celanese Corporation at Bishop was visited on August 11.

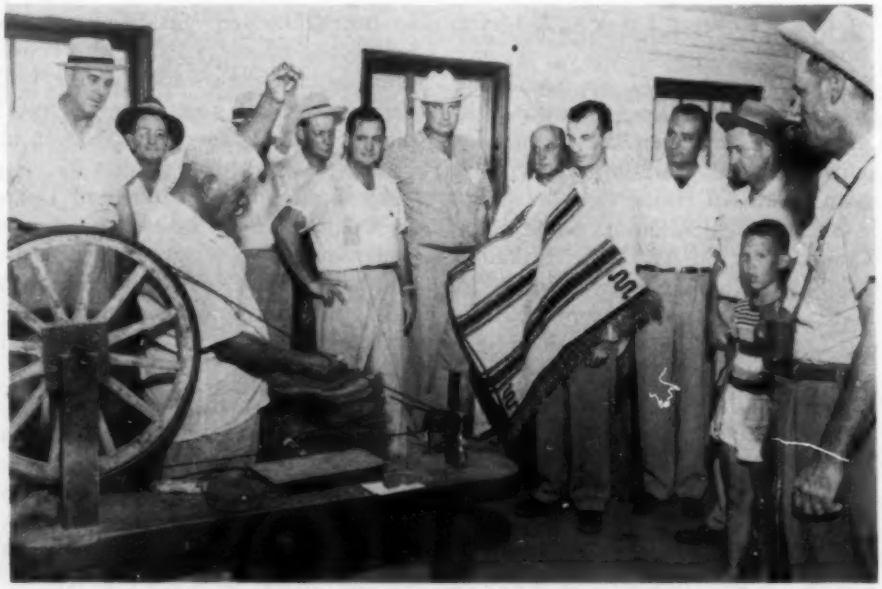
Dr. E. H. Poteet, president of Texas A. & I., delivered the welcoming address for the course, and Frank C. Smith, president of Houston Natural Gas, gave the commencement address.

Here are the discussion sections and leaders:

Gas economics. The section on gas economics had as its supervisor Dr. Joe E. Brown, chairman of the Department of Economics at Texas A. & I. Lecturer was Mr. Fellows, who is secretary of Houston Natural Gas.

Records and reports. Ralph C. Russell, professor of business administra-

BACK TO SCHOOL goes C. R. Fussell, right, of El Paso Natural Gas Company. Curtis M. Smith, left, chairman of the SGA committee which planned the course, presents Fussell with manual used as a text, while Dr. Frank Dotterweich, director of the Division of Engineering at Texas A & I, looks on.



AT THE KING RANCH natural gas company men watch a ranch employe spin wool to make the famous "Running W" horse blankets. The King Ranch visit was one of three field trips taken during the course.

tion at Texas A. & I., was supervisor of the section on records and reports.

Load building. For the section on load building, supervisor was Harry C. Canup, director of the Commerce Extension Service, Oklahoma A. & M. College. Dr. Dotterweich was lecturer.

Essentials of administration. Supervisor of the section on essentials of administration was Dr. Edwin W. Mumma, dean of the College of Business Administration, University of Texas. Lecturers were Joseph K. Bailey, assistant dean of the University of Texas College of Business Administration; Max H. Jacobs, public relations counselor; Dr. J. C. Jernigan, professor of education and dean, Texas A. & I.; Edward McCleskey, training manager for Tennessee Gas; Dr. Ted Skinner, chairman of the Department of Speech, Texas A. & I.; Dr. S. Boyd Stewart, professor of English and director of the Division of Arts and Sciences, Texas A. & I.; and Gene Edmondson, safety engineer for Texas Eastern Transmission Corporation.

Participants in the course were Harvey S. Cain and H. E. Jacobsen, Texas-Illinois Natural Gas Pipeline Company; F. C. Callison and O. M. Heartsill, Jr., Oklahoma Natural Gas; H. B. Dempsey, S. H. King, and M. M. Williams, Lone Star Gas Company.

E. M. Doherty, Pioneer Natural Gas Company; F. M. Elder and W. B. Nesbitt, Tennessee Gas; C. R. Fussell, El Paso Natural Gas Company; J. Fred Gresham and J. C. Riffe, Arkansas Louisiana Gas; Bruno Giovanini and Samuel M. Holland, Southern Union Gas, and S. L. Hardin, Houston Pipe Line Company.

John D. Johnston, Jr., Alabama-Tennessee Natural Gas Company; Thomas B. Kelley, Texas Eastern; J. Harry Lambdin, Mississippi Valley Gas Company; S. L. Lamkin and J. O. Strawhun, Transcontinental Gas Pipe Line Corporation; E. R. Owings, Southern Natural Gas Company, and Howard W. Putnam, Alabama Gas Company.

Jack Roberts, United Gas Pipe Line Company; J. W. Roberts, Trunkline Gas Company; J. O. Schuyler and S. C. Shaw, United Gas; J. S. Sullivan, Houston Natural Gas, and Erwin C. Thompson, Empire Southern Gas Company. —**The End**

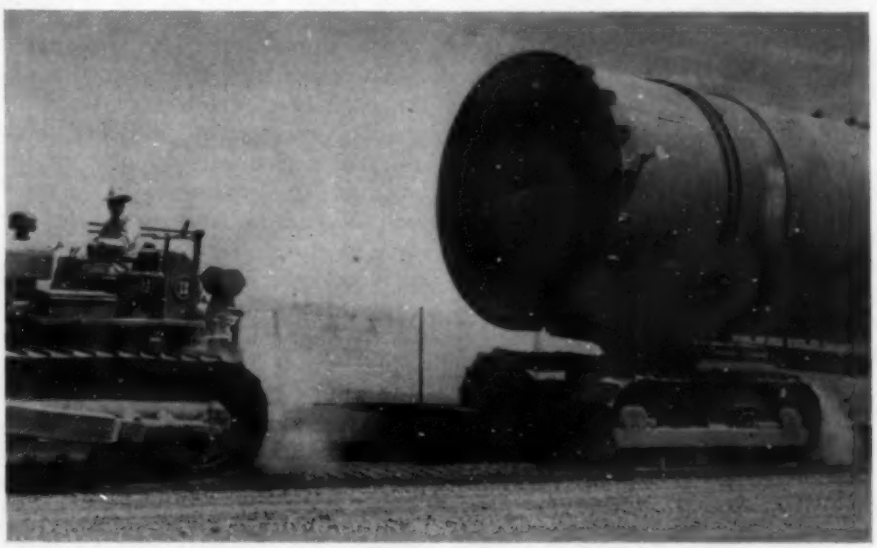
FINAL CHECK is given moorings before the big de-ethanizer is started on its way. The 30-mile trip from Benedum to El Paso Natural Gas Company's Midkiff gasoline plant was made in one day.

Heaviest Vessel on the Move

El Paso Natural moves 324,000 pound vessel 30 miles across West Texas prairie.

ONE OF THE HEAVIEST vessels ever hauled in one piece was moved 30 miles across West Texas recently by El Paso Natural Gas Company. To move the 77-foot de-ethanizer tower, the company designed a super aetheia wagon, and built it at the company shop near El Paso.

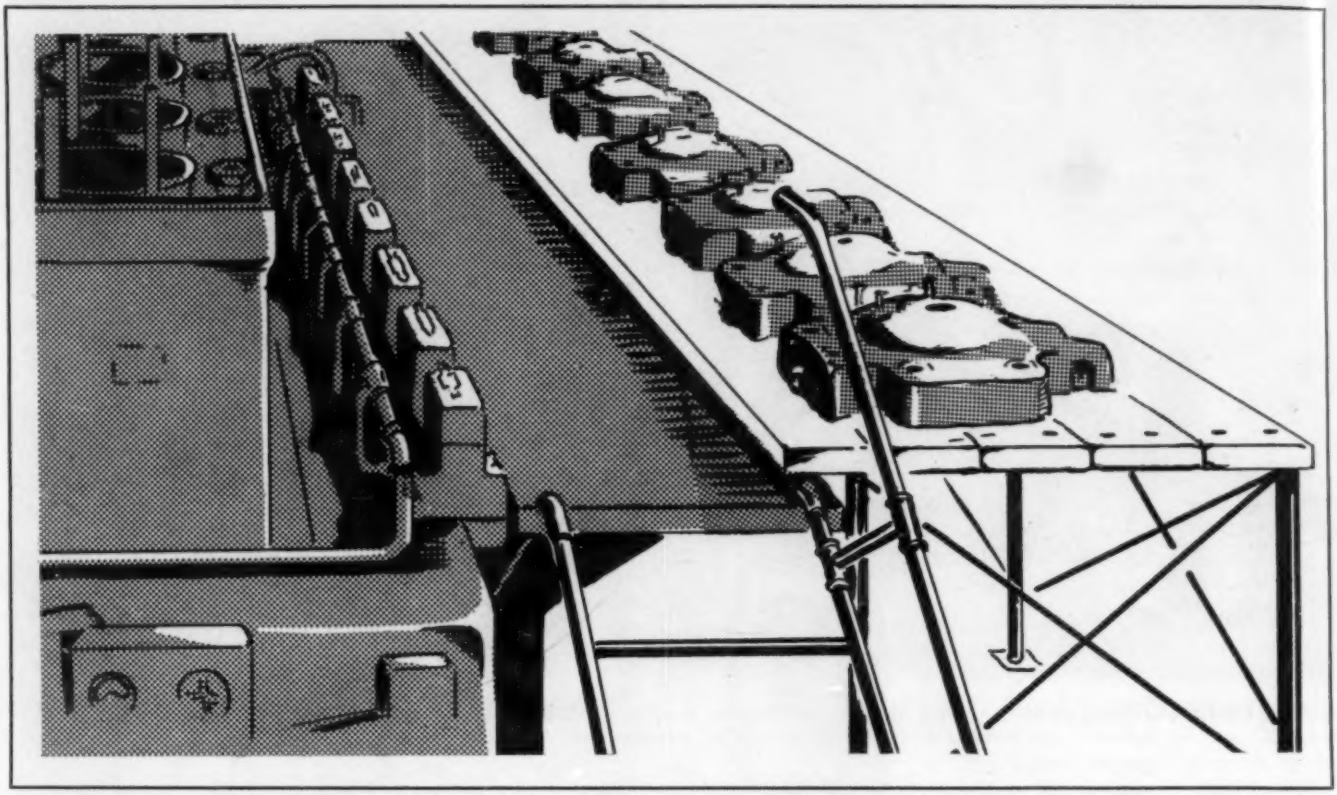
The problem was to move the vessel from a railroad siding at Benedum, Texas, to the company's Midkiff gasoline plant and compressor station. Since it weighed 324,000 pounds—just 265,760 pounds too much for Texas roads—the trip was made in the "bar ditch," a sandy strip beside the highway.



ALONGSIDE HIGHWAY in the "bar ditch," a special road graded by the company just for the purpose, the de-ethanizer is pulled to its destination by two tractors.

With two tractors pulling the load, the job was done in one day, and the vessel was erected at Midkiff several days later. The aetheia wagon has since been used by El Paso Natural to move a large absorber and propane storage tanks.

The company's Midkiff Plant is the center of its construction activity in the Permian area. All gasoline absorption, purification, and dehydration facilities from the Spraberry Trend are concentrated there. When the plant is complete, it will deliver daily about 200,000 gallons of propane, 150,000 gallons of butane, and 126,720 gallons of 12-pound gasoline at capacity operations. Start-up is scheduled for early fall. **—The End**



. . . Building a Portable Scaffold four feet wide and the length of the catwalk on the engine. When time for overhaul comes, it can be erected in short order and the cylinder heads and other parts dismantled from the engine can be stored on the platform, eliminating the need for lowering them to the floor.

How to maintain . . .

Peak Efficiencies on Compressor Engines

Here are some ideas that will save you time and money.

By ERROL R. WAGNER, Stanolind Oil & Gas Company, Odessa, Texas

THE POWER END of a gas engine driven compressor can be kept in good mechanical condition with 1 percent or less downtime. This can be done on a 1600-hp eight-cylinder engine with 50 or less man hours of labor per month which include inspection, minor repairs and overhauls.

A compressor maintenance program can be developed which will keep the units in good condition, reduce downtime to a minimum and hold maintenance and operating costs down. Such a program should be designed to get maximum safe use from all wearing parts with a minimum amount of labor and downtime. Such a program was used to reduce downtime from 4.7 to 1.04 percent in a compressor station having ten 1600-hp, eight-cylinder, two-cycle engines. The procedure advocated to accomplish this will be presented under these headings:

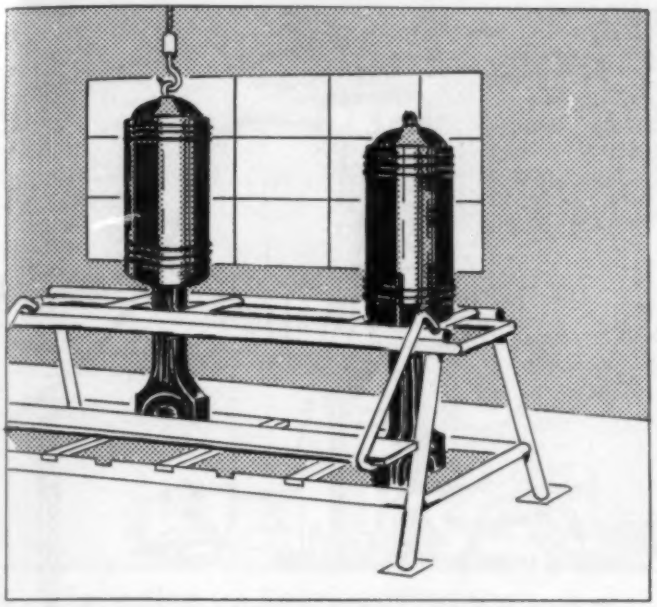
- Preventive maintenance
- Repair and overhaul of engines
- Material selection and life

Preventive maintenance. Preventive maintenance will be defined as minor work that can be done between overhaul periods which will minimize unit downtime and over-all maintenance and operating expense. It includes a review of operating conditions which can be observed and recorded for indications of the condition of the various parts of the engine.

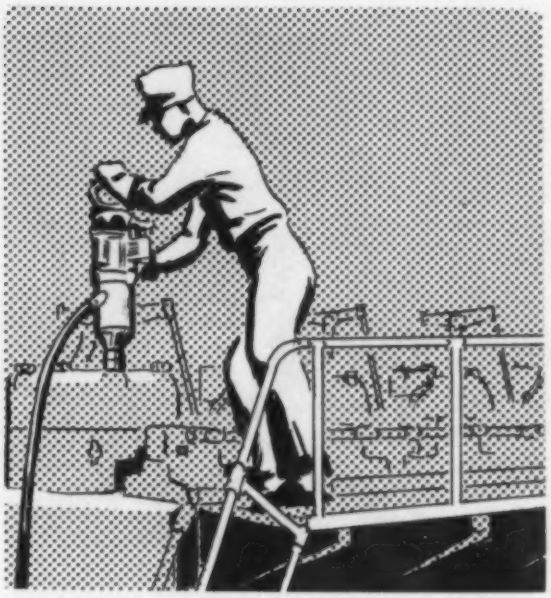
Before placing a new compressor plant in operation, the operating personnel should set up a preventive maintenance program designed to obtain the best performance from the engines and to maintain a close check on the mechanical condition of the engines. The routine to be followed will depend to some extent on the type of engine being used. The practices brought out in this paper will apply to most two-cycle engines. Preventive maintenance on the power cylinders is probably the most important and will be discussed first.

An internal combustion engine converts energy into power by igniting a mixture of fuel and air. In order to obtain the best performance from an engine, it is necessary that the spark or ignition, the air and the fuel be brought together in the proper

Improve Overhauls by . . .



. . . Fabricating Piston Racks to provide a convenient and safe place to work on pistons. Notice the seat which is placed at convenient height. The pistons are lifted out of the engine and into the rack by means of an eye screwed into the piston head.



. . . Using Air-Operated Impact Wrenches to remove practically all the nuts, and bolts from engine when dismantling and reassembling. A five-spot air piping manifold is used to make it possible to operate several impact wrenches at the same time.

amount at the proper time. Each is as important as the other in obtaining good engine performance.

The ignition system is the heart of an engine. It should be kept in as near perfect condition as possible at all times. Magnetos should be reconditioned in a reputable magneto shop at least once each year, preferably every six months. Coils should also be checked in a reputable magneto shop every year.

Spark plugs should be removed from each engine and replaced with reconditioned tested plugs periodically. The period of operation between change outs will depend on the type plug used and the operating conditions. Certain plugs can be operated ten weeks or more and give good engine performance. Magneto or ignition timing should be set as accurately as possible to give best results.

A timing light used to check ignition timing on automotive equipment is ideal for this purpose and should be used. If the above procedure is used, very little ignition difficulty will be experienced.

On a two-cycle gas engine, air is used for scavenging or removing the burned charge from the power cylinder and providing air for the combustion of fuel. The volume of air remaining in the cylinder for combustion is relatively constant regardless of the load on the engine. The fuel is admitted to the cylinder through a fuel injection valve which opens a fixed distance.

The amount of fuel entering the cylinder is controlled by the fuel pressure on the fuel manifold which in turn is controlled by the main fuel valve operated by the governor. As the load increases on the engine, the governor opens the main fuel valve farther, causing a higher pressure on the fuel manifold which in turn forces more fuel into the cylinder through the fixed opening of the fuel valve.

When the engine is first placed in operation, an engine indicator is used in conjunction with the pyrometers on the engine to adjust the fuel and air to the individual cylinders, balancing the load so that each cylinder develops the same horsepower for any given load. When the engine is properly balanced by this method, the pyrometer reading will be approximately the same on each cylinder for any given load.

Since the air charge in the cylinder does not vary with the load, the cylinder exhaust temperature is used, in effect, to determine the ratio of the air and fuel burned in the cylinder. The more fuel burned in the fixed volume of air, the higher the temperature.

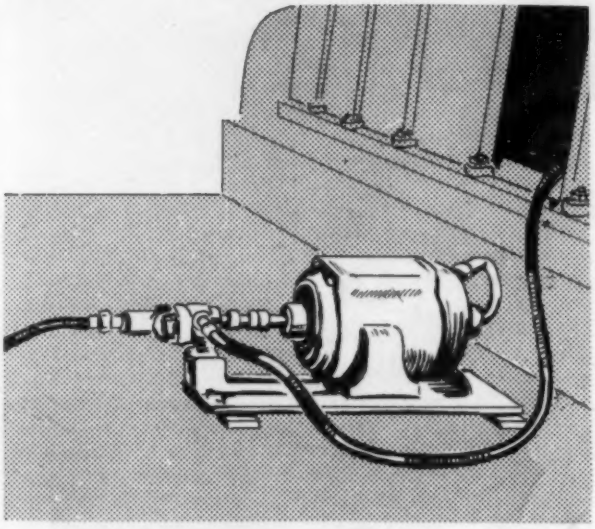
After the engine has been balanced with the indicator as outlined above, the common practice is to keep the exhaust temperatures balanced as indicated by the pyrometer on the various cylinders. This theoretically keeps the horsepower developed by the engine evenly distributed to the various power cylinders.

In the operation of filling the power cylinder with an explosive mixture, the air should be of sufficient quantity, and the gas properly controlled. The air is normally supplied by a scavenging air compressor on the unit. This compressor is equipped with suction and discharge valves which may fail.

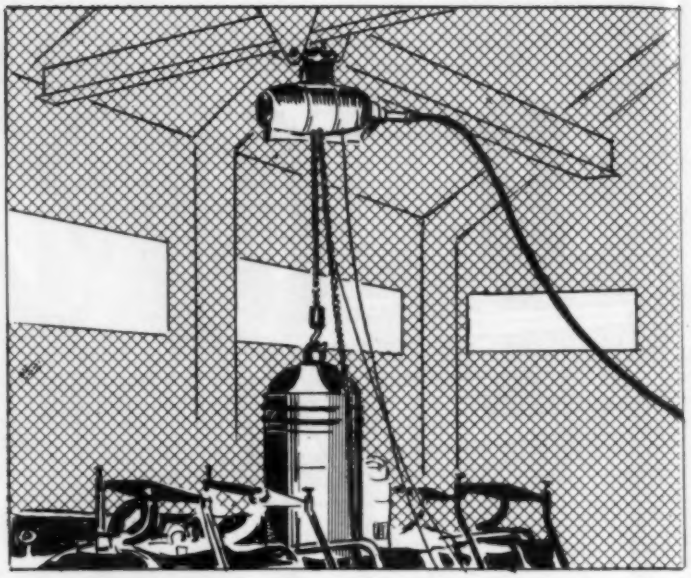
The air is usually pulled through an air filter which may become restricted. Scavenging air ports may become plugged with carbon. In order to prevent maintenance resulting from a shortage of air due to any of these three possible causes, it is desirable to install a mercury manometer on the discharge of the scavenging air compressor on each engine.

A high pressure will indicate carbon in the power cylinder ports, while low air pressures will indicate a failure in the scavenger air compressor or air filter. This pressure should be recorded approximately once each shift

Improve Overhauls by . . .



. . . Pumping Oil From Crankcase with a Portable Pump. The motor is explosion proof and the pump is gear type. The oil can be stored in barrels.



. . . Using a One-Ton Air Hoist throughout the job. This hoist can be hooked to the overhead crane which is more or less standard in every compressor building.

so that normal pressure can be established and unusual conditions observed.

As an aid in checking the performance of the engine, it is also advocated that a mercury manometer be installed on each engine and connected downstream from the governor fuel valve. The operators will soon learn to associate this fuel pressure with the gas load being handled and the manometer will give a visual means of determining whether the fuel valves are generally set at the proper clearance. Excessive clearance on all the fuel valves on an engine will result in a high fuel pressure and may reach the point where the unit will not handle the gas load at the rated speed. Excessive valve clearance also causes excessive pounding on the fuel injection valve and seat resulting in decreased valve life.

Balancing the load on the various power cylinders of a two-cycle gas engine with the pyrometers is an approved practice; however, when operating continuously at or near fuel load conditions, it is desirable that the engine be checked quite often with an indicator.

As pointed out previously, the cylinder exhaust temperature indicated by the pyrometer is a measure of the air-fuel ratio. It is an *indication* but not a *measure* of the horsepower developed on each cylinder. As an example, assume that the air ports in one cylinder are becoming restricted with carbon, causing a reduction in the amount of air entering the cylinder.

The fuel to air ratio is reduced; therefore, the temperature on the cylinder tends to increase above the temperature on the exhaust of the other cylinders. The operator observes this and reduces the amount of fuel entering the cylinder, bringing the temperature back to the average of the other cylinders. The cylinder on which the fuel has been reduced is no longer carrying its share of the load. Since no load has been removed from the engine, the other cylinders are now required to develop additional horsepower. If four cylinders on an eight-cylinder engine are reduced in this manner, considerable horsepower is transferred to the other cylinders, overloading them. The end result is that all cylinder exhaust temperatures are running above normal.

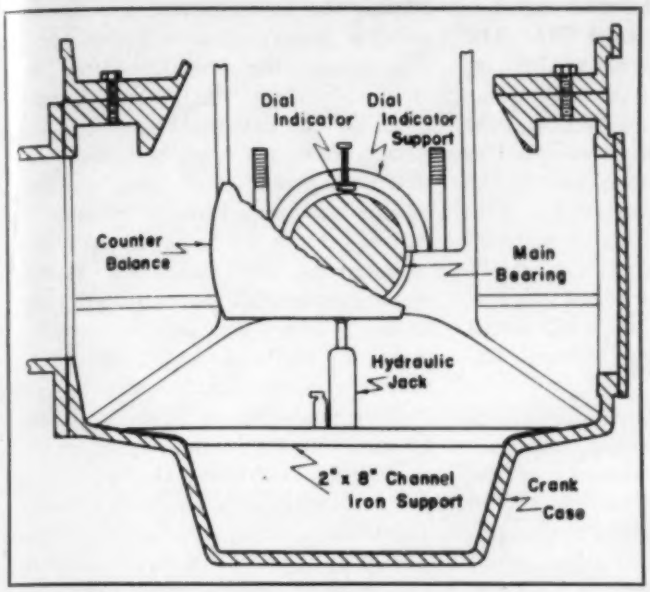
If indicator cards were run on an engine under these conditions, it would be found that the four cylinders having the dirty air ports would have low peak cylinder pressures, while the four cylinders with the clean ports would have high peak cylinder pressures. High peak pressures may cause ring failures and will accelerate ring, cylinder and bearing wear.

The best practice is to balance the peak pressures on the cylinders frequently with an engine indicator. This will give more assurance that each cylinder is carrying its share of the load. If the cylinder exhaust temperature on some of the cylinders is high, the cause should be found and removed. If the ignition is good and properly timed, the air ports to the cylinder are probably becoming restricted with carbon and should be cleaned.

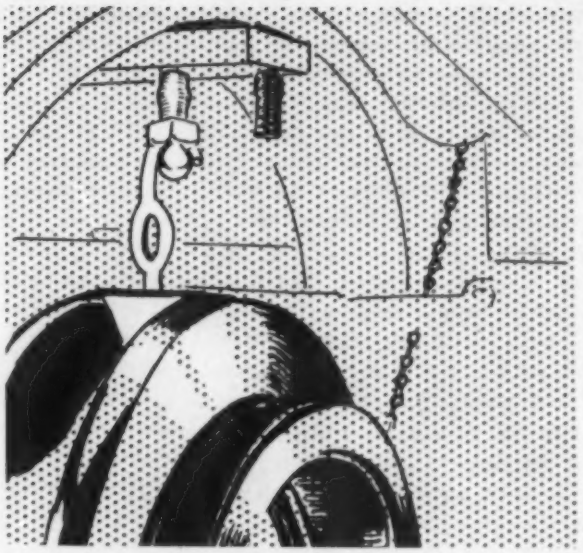
For best performance of the engine it is advocated that each engine be fitted with proper facilities for connecting the indicator, and each operator be trained in the use of the indicator so that he can check the performance of the engine frequently and make adjustments when necessary. For best results it is desirable that peak pressure cards be run on one or two engines each shift so that all engines will be checked approximately every two days. This practice will make it possible to locate trouble spots and make corrections before severe damage occurs. The best possible distribution of load and minimum peak pressures will result in maximum ring, cylinder and bearing life.

Another important part of a preventive maintenance program is the periodic "tune up." It was previously pointed out that spark plugs should be replaced periodically with reconditioned plugs.

Improve Overhauls by . . .



. . . Speeding up Bearing Inspection. By placing a section of channel iron across the lower part of the crankcase and under the crank shaft, a hydraulic jack can be used to lift the crank shaft off the lower main bearing shell. During the lifting operation, a dial indicator is attached to a bridge which is installed over the crank shaft. After raising the shaft approximately .002 inch (as read on the dial indicator) the lower bearing shell can be readily rotated from under the shaft. A flexible steel cable with a "T" handle on one end and a small bolt in the other is used for removing this shell.



. . . Hanging Main Bearing Caps Inside the Crankcase. This simple hanger makes it unnecessary to manhandle the main bearing caps through openings in the crankcase, saving time, effort and possible damage to the engine. The piston wrist pin clearances are checked by clamping a dial indicator to a "C" clamp attached to the connecting rod and contacting the piston skirt. The piston is raised with a chain hoist while in the unit. The difference in the dial indicator reading while the piston is supported and unsupported gives wrist pin clearance.

This should be scheduled along with other "tune up" practices so that the work will be uniformly distributed from week to week. This is beneficial in two ways. Assume that a compressor station has ten engines, and it is planned that all engines would be checked after ten weeks of operation. If such a plan were used, all of the engines would be approaching a condition where minor difficulties with ignition, etc., could reasonably be expected. In case of an overload, it would be possible to have the entire station go down.

In addition it is possible that other unanticipated work could arise which would make it impossible that the engines be checked when scheduled. If one engine is "tuned up" each week, all other engines should be in better condition than the engine being "tuned." Also, only a small amount of work is required each week. If it is necessary to postpone the "tune up" of one engine for a time, very little loss in efficiency can occur.

The "tune up" of an engine should include the testing of all shutdown devices, inspection of magneto points, changing spark plugs, checking ignition timing and other equipment and devices which serve an important function in the operation of the engine. A record of these tests and the operating conditions should be made to be used in following the condition of the unit and equipment. A sample of a form used for this purpose is shown in Table 1.

TABLE 1
Engine Tune-up Record

UNIT No. 5—SOUTH — YEAR 1953

Date	1-29-53	4-6-53	9-1-53	10-6-53
Initial	F.L.C.	F.J	H.E.P.	F.J.
Water Temp. Shutdown	170	170	175	180
Oil Press. Shutdown	18	15	17	20
Overspeed Shutdown	350	345	340	355
Emergency Shutdown	OK	OK	OK	OK
Magnetos	OK	OK	OK	OK
Change Spark Plugs	OK	OK	OK	OK
Ignition Timing	OK	OK	OK	OK
Fuel Injection Valves	OK	OK	OK	OK
Lubricators	OK	OK	OK	OK
Pyrometer	OK	OK	OK	OK

Remarks: 10-8-53, Cleaned Ports, Cylinders 2 & 3.

OPERATING TESTS

Oil Pressure	43	44	42	42
Fuel Pressure	29	28.5	32	35
Scavenger Pressure	9.5	10	9	10
1st. Stg. Suct. Press.	9.6	9.5	9.3	10.8
1st. Stg. Pocket Set	10.25	10.25	6.5	6.625
Engine RPM	300	300	310	309

PYROMETER AND PEAK PRESSURE READINGS
Degrees Fahrenheit

Cylinder No. 1	610	620	700	700
Cylinder No. 2	610	620	645	720
Cylinder No. 3	620	610	645	745
Cylinder No. 4	620	600	640	695
Cylinder No. 5	610	620	660	705
Cylinder No. 6	620	610	660	680
Cylinder No. 7	610	610	665	680
Cylinder No. 8	610	620	640	670

Repair and overhaul of engines. Prior to the use of the procedure outlined in the following pages, the overhaul of the power end of an eight-cylinder engine required approximately 475 manhours. At the present time the power end of a compressor is being overhauled in approximately 200 man-hours. This decrease in manhours and accompanying reduction of downtime is due primarily to the coordination of the maintenance crews. In addition to this several time saving devices are now employed in the overhaul.

One of the devices is a one-ton air hoist. This hoist will lift one ton at the rate of approximately 17 feet per minute. The use of this hoist rather than a chain operated hoist has resulted in a saving of 36 man-hours and 11 hours compressor downtime in pulling and replacing the power pistons. The use of an eight-ton chain hoist normally provided will take three men a total of 40 man-hours to pull and replace these pistons. This work is now done with two men in four man-hours.

When the overhaul was started, three crews of four men each were used so that overhaul work could be performed 24 hours a day. As a result of the above improvement, the man-hours required for the overhaul were reduced from approximately 475 man-hours to 200 man-hours per unit. Downtime per unit was reduced to approximately 48 hours or six shifts. A breakdown of each shift follows:

Shift No. 1—Remove cylinder heads, coils, spark plugs, fuel injection valves, crankcase doors and covers, check wrist pin clearances, remove connecting rod bearings and pull and rack power pistons.

Shift No. 2—Inspect and re-install main bearings. Clean carbon from ring lands on pistons and fit with new rings.

Shift No. 3—Inspect and re-install main bearings. Clean carbon from ring lands on pistons and fit with new rings.

Shift No. 4—Inspect and adjust compressor and scavenger connecting rod bearings, clean jacket water connections, clean carbon from air intake ports, mike pistons and cylinders and run glaze buster on cylinders.

Shift No. 5—Install pistons in cylinders, adjust connecting rod bearings, and start assembling top part of unit.

Shift No. 6—Complete reassembly of unit, clean crankcase, start unit and begin moving overhaul platforms, etc., to next unit to be overhauled.

Material selection and life. The life of replacement parts used in repairing the engines has considerable bearing on the amount of downtime and the amount of work required to keep an engine in good condition. All work performed on an engine is to replace or correct failure of material or equipment. Through a study of work performed on various engines, it is possible to locate the weak points giving a basis for correctional improvement.

Material failures are the result of poor or incorrect material, improper design or the mis-treatment of the material being used. The first step in the analysis of material is the preparation of a complete downtime report similar to that shown in Table 2. Assuming that this record reflects only downtime for the repair or replacement of faulty material, and not inefficiencies in the performance of the actual work, it can be used to locate failures causing downtime. Without this report only the obvious weaknesses will be noticed.

After it is determined from the downtime report that a specific problem exists, the second step is to thoroughly analyze the cause of the failure, determining whether the failure resulted from poor or incorrect material, improper design or the mis-treatment of the material. After completing this investigation, it is usually possible to make improvements which will extend the operating time between failures of this particular part.

As an example of this problem and what can be accomplished, the solution of a power piston ring problem will be presented. Prior to the investigation of this problem, the practice followed at this compressor station was to replace all power piston rings annually. Many ring failures were experienced between ring replacements, causing considerable downtime.

After analyzing the problem, it was decided a better lubricating oil would be desirable and that a change in ring design would probably be beneficial. The use of a better lubricating oil was started and one set of piston rings of an improved design was installed for an experimental run. After observing the improvements resulting from these two changes after one year of operation, it was decided to use the better lubricating oil and install rings of the new design in all units.

This station now replaces power piston rings every two years and very seldom experiences ring failure. A problem of this nature is of major importance and will show considerable improvement in both downtime and maintenance expense; however, there are many minor problems experienced in engine operation that can be analyzed and corrected and give the same results.

The downtime report shown in Table 2 reflects an annual downtime of 1.04 percent for the power end. This report is for a compressor station having ten 1600 horsepower engines.

Many of the problems encountered with the engines in this station have been solved. The downtime for maintenance of the power end has been reduced from 4.7 percent since the start of operation approximately four years ago. During 1953, an average of 500 man-hours per month was used for the maintenance of these engines, including the bi-annual overhaul.

In the maintenance of a compressor station the study of material selection and life is a never ending problem. Material manufacturers are constantly endeavoring to improve material and design of parts.

TABLE 2

Maintenance Report—Compressor—Downtime—1953

	Percent Down Time	Percent Total Down Time	Total Hours	NORTH 1	NORTH 2	NORTH 3	NORTH 4	NORTH 5	SOUTH 1	SOUTH 2	SOUTH 3	SOUTH 4	SOUTH 5
Engines													
Lube Oil System	0.07	5.73	64.5	....	7.5	2.5	9.75	....	5.25	4.00	18.5	11.75	5.25
Jacket Cooling	0	0.02	2.25	.25	.25	.25	1.25	.25	....	....	....	....	....
Fuel System	0.02	1.42	16.0	.5	.5	.75	1.0	.75	1.25	4.5	.75	2.0	4.0
Ignition System	0.03	2.60	29.25	.5	2.0	1.5	5.0	3.25	1.0	6.75	2.0	2.5	4.75
Scavenging	0.05	3.78	42.5	8.5	13.25	4.25	3.25	1.0	.75	.75	.5	2.75	7.5
Cleaning Ports	0.03	2.11	23.75	.75	1.25	1.5	2.75	....	3.5	5.25	2.5	2.75	3.5
Rings	0.03	2.51	28.25	7.25	....	....	....	....	7.75	3.75	3.75	1.0	4.75
Tune-up	0.12	8.89	100.0	9.25	9.75	11.0	12.5	9.5	11.75	13.5	6.75	6.25	9.75
Piston Heads	0.24	18.32	206.0	7.25	8.75	6.5	8.5	35.0	22.0	24.25	48.5	38.75	6.5
Governors	0.01	0.47	5.25	....	....	2.5	....	.5	....	1.25	....	1.0	....
Instruments	0	0.13	1.5	....	....	....	....	....	....	.25	....	.25	1.0
Gaskets	0	0.36	4	....	....	....	2.5	....	....	....	1.25	.25	....
Overhaul	0.30	23.48	264.0	44.75	41.25	40.5	52.5	46.0	39.0	....	....	....	....
Pistons	0.02	1.53	17.25	....	....	....	....	....	17.25	....	....	....	....
Cylinders	0.08	6.53	73.5	....	....	.25	....	....	17.25	23.0	....	....	33.0
Inspection	0.01	0.87	9.25	4.5	....	....	.25	....	4.5	.5	....	....	....
Plant Shutdown	0.01	0.89	10.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Air Filter	0	0.22	2.5	....	....	....	....	....	....	1.5	1.0	....	....
Misc.	0.02	1.20	13.5	....	1.25	1.5	2.25	1.25	1.75	1.25	1.0	2.0	1.25
Compressors													
Packing	0.01	0.76	8.5	....	....	....	....	....	....	3.5	....	5.0	....
Jacket Cooling	0	0.27	3.0	....	....	....	....	....	....	....	3.0	....	....
Rods	0.02	1.93	21.75	....	....	....	....	....	....	14.0	....	7.75	....
Magnafluxing	0.05	4.22	47.5	5.25	5.5	6.5	3.75	4.75	5.25	4.00	3.25	3.75	5.5
Valves	0.09	7.38	83.0	6.5	6.0	3.75	5.25	10.0	7.25	9.25	16.75	5.0	13.25
Gaskets	0.01	0.80	9.0	....	....	....	....	....	....	....	....	9.0	....
Cross Heads	0.01	0.87	9.75	....	9.75	....	....	....	....	....	....	....	....
Clearance Pockets	0	0.18	2.0	1.5	....	....	.5	....	....	....	....	....	....
Overhaul	0.03	2.0	22.5	8.5	....	....	....	....	....	....	6.75	7.25	....
Misc.	0	0.35	4.0	....	....	....	....	....	.25	1.5	1.0	.75	.5
Total	1.26	100.00	1124.75	106.25	108.0	84.25	112.0	113.25	146.75	123.75	118.25	110.75	101.5
Percent Downtime Engine:	1.04	....	.....	0.10	0.10	0.09	0.12	0.11	0.15	0.10	0.10	0.08	0.09
Percent Downtime Compressor:	0.22	....	.....	0.02	0.02	0.01	0.01	0.02	0.01	0.03	0.04	0.04	0.02
Total	1.26	....	.....	0.12	0.12	0.10	0.13	0.13	0.16	0.13	0.14	0.12	0.11

ACKNOWLEDGMENT

Original presentation was before the 33rd Annual Meeting, Natural Gasoline Association of America, Dallas, April 21, 1954.

—The End

SIX MILES AT SEA, Brown & Root's "Dredge Booth" lays a ten-inch pipe line in 40 feet of water. The "dredge is 187 feet long, 34 feet wide, and the pipe-laying ramp is 7 feet wide.

A PIPE LINE INDUSTRY Photographer visits . . .

New Pipe-Laying Barge, "Dredge Booth"

Sea-going jack-of-all-trades operates as a ramp barge to lay the pipe, and then doubles as an underwater ditching machine.

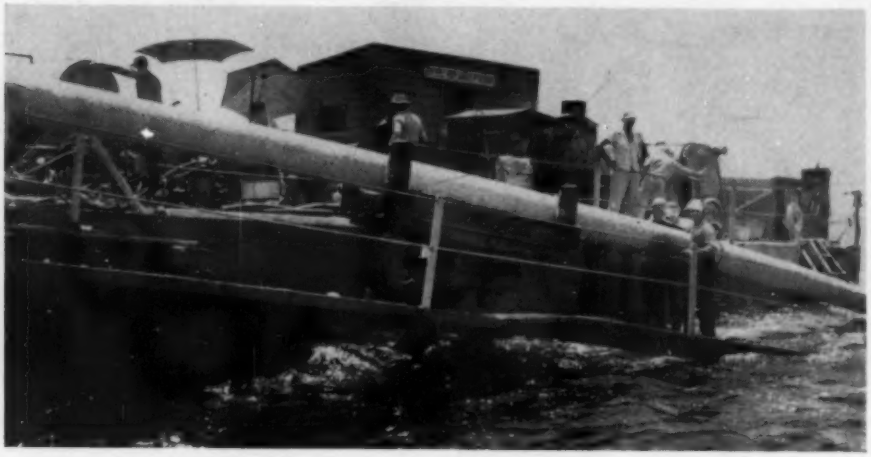
RANGING THE WATERS of the Gulf from one end of the Louisiana coast to the other, Brown and Root's "Dredge Booth" has been laying one offshore pipe line after another to bring newly-discovered oil and gas to shore. The work has been without letup, since bad weather will soon curtail this operation.

Reacting to this prolonged and intense pace, members of the 38-man crew sometimes refer to their craft as the "Drudge Booth." Actually, the term "dredge" is a misnomer; the vessel in reality is a pipe laying barge. Moreover, it is a jack-of-all-trades in offshore pipelining, operating as a ramp barge to lay the pipe—and then doubling as an underwater ditching machine.

When the barge is rigged for pipe laying, structural steel braces and wooden decking cover the center well that runs for about one-third of the barge's length. A sideboom tractor and a heavy mobile crane ply back and forth over the decking, picking up pipe from the supply barges and lining it up for stovepiping into the Gulf.

There are four work stations on the seven-foot-wide ramp which runs the barge's length on the port side. At the first station, the pipe is lined up and partially welded; at the second station, the weld is capped; at the third station, the weld is X-rayed, primed, and coated with hot enamel;

FOUR-FOOT WAVES which continually smack against the barge have little or no effect on the efficiency of the pipe laying operation, since all line-up equipment is integral with the barge itself. Eight anchors hold the barge in line.



AT THE STERN pipe enters the water. When the barge is laying line in 50-foot-deep water, a boom or stinger on the stern is used to support the line 30 feet or so behind the barge, minimizing any danger of buckling it as it is lowered to the Gulf floor.

FROM THE SUPPLY BARGE, a life-jacketed pipeliner gives the signal to the crane operator on board the "Booth" to hoist the pipe aboard. Before each joint is lined-up, it is pigged on deck on the "Booth."

and at the fourth and last station, a concrete field mold is wrapped around the pipe and poured with grout.

So highly organized is the pipe laying procedure that Brown and Root frequently laid over 2000 feet of 10¾-inch line per ten-hour day off Grand Isle in the Gulf of Mexico. A portion of this line was laid in water 50 feet in depth.

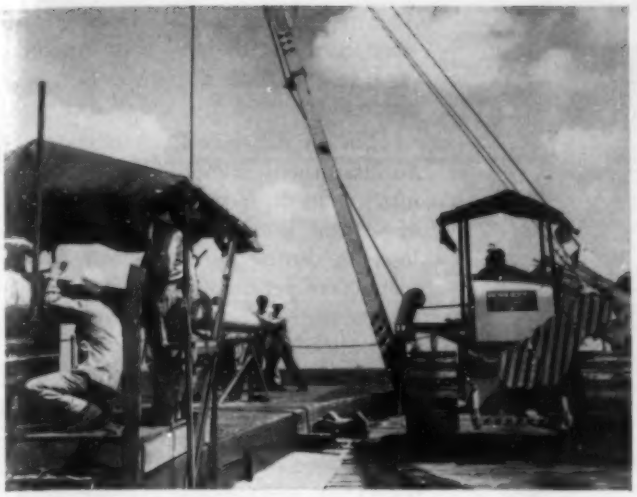
A factor contributing heavily to the smooth and efficient operation is the handling of the anchor lines. On each side of the barge there are four anchors: 1 bow, 2 breast, and 1 stern. Each anchor has a 1400-foot line, which permits a single tug to work all anchors, moving them one by one without interfering with the pipe laying operation.

Backing up the vessel is a service fleet of three tugs, three supply barges, and various small craft. One tug works anchors; another supplies materials from shore; and the other handles the pipe supply barges.

When a stretch of line has been laid out, the "Dredge Booth" undergoes a radical change. The wooden deck over the center well is removed; the braces beneath it are cut out; and two spuds are inserted in the sleeves at either end of the barge. High-pressure pumps replace the battery of welding machines and an underwater ditching machine is lowered through the well onto the underwater pipe.

These underwater machines combine high-pressure jets and suction dredging. The jets sluice away at the soil on either side and below the pipe line, washing the cuttings into the suction lines which carry the spoil over the side of the barge. While this operation is going on, the anchor lines are handled as before; yet the barge is not totally dependent on them for keeping its alignment above the center of the pipe line. The two spuds at bow and stern of the barge straddle the pipe, holding the "Booth" in a fixed position while the ditching machine travels the length of the center well.

Pipeliners at Brown & Root are proud of this craft since it represents the sum total of improvements and adjustments for this type craft over a period of years. Almost every member of the crew is a veteran company employe and has had a hand in improving the operation of the vessel.

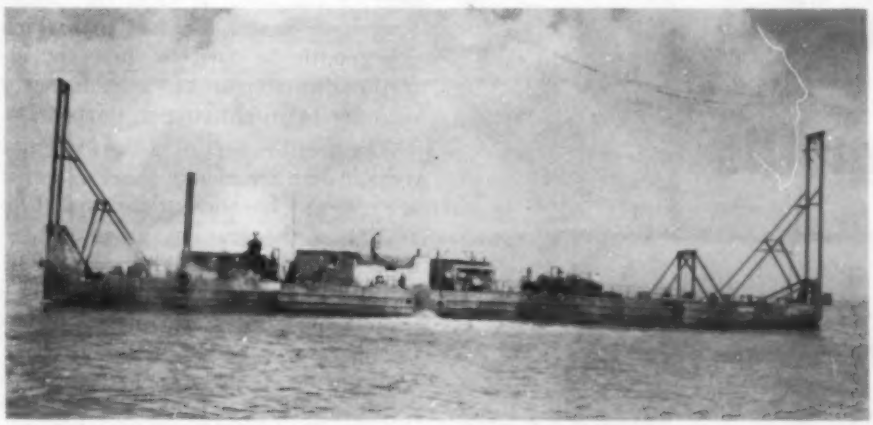


SIDEBOOM TRACTOR (left) lines up the pipe for the first work station. The wooden docking beneath the tractor covers the well used in the underwater ditching operations.

ADJUSTABLE SLIPS (right) permit the rubber-covered rollers to be adjusted to proper height for the laying operation. Pointing to the small slips is Ben Baldwin, barge foreman, who invented them.

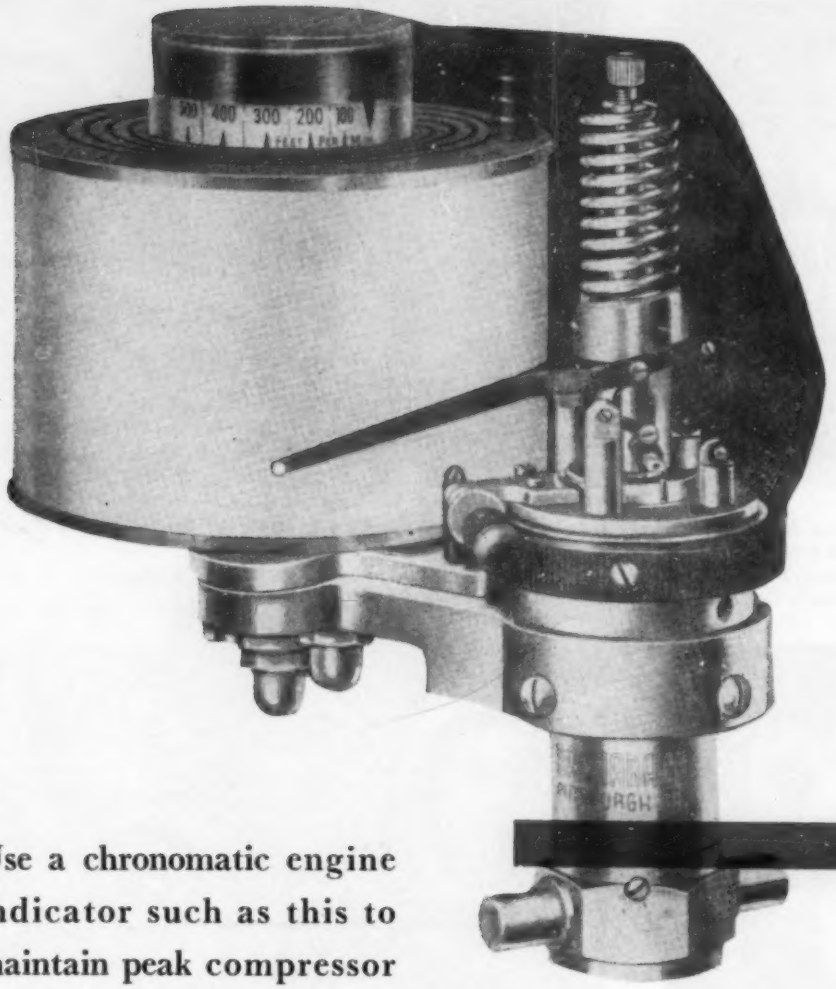
NEAR THE SECOND WORK STATION (left) where welds are completed, W. D. (Bill) Schoolcraft, Brown & Root's general superintendent, confers with Spread Superintendent Ray Austin.

CONCRETE IS VIBRATED (right) inside the metal mold at the fourth work station just before the pipe enters the water. In traversing the 187-foot-long barge, the pipe slips about ten feet.



A CHANGED SILHOUETTE (left) is presented by the "Booth" during the ditching operation. The two spuds at either end hold the barge over the center of the pipe.

DITCHING OPERATIONS UNDER WAY (right), with the underwater machine traveling along the pipe below the well in the center. Water at 350 pounds per square inch sluices at the ocean floor, and a suction pump picks up the cuttings and propels them over the side.



Use a chronomatic engine indicator such as this to maintain peak compressor cylinder efficiency. Save the charts on the following page and read on for more details on . . .

How Indicator Cards Spot Compressor Ills

By EARL Y. PALMER, The Atlantic Refining Company, Lovington, N. M.

ONE OF THE most costly phases of compressor operation is maintaining peak efficiency in the compressor cylinder. Many compressor operators fail to make use of some of the simple methods for maintaining a compressor cylinder in first class operating condition at nominal cost and little loss of horsepower due to downtime and faulty parts.

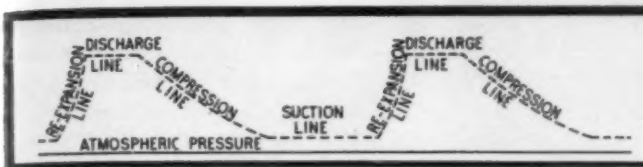
Most operators make scheduled visual compressor cylinder inspections. A large percentage of these inspections turn out to have been unnecessary at the time the inspection was made.

This discussion will center around an instrument, a method of using the instrument to indicate when a visual inspection is necessary, and what to look for during the inspection. An indication of pending compressor failure may often be obtained a considerable time ahead of actual failure. After such an indication, the operator may plan repairs to fit his working and operating schedules, thus saving prolonged downtime and paying premium wages for unexpected repairs.

Most operators are familiar with the pressure engine indicator card instruments used for taking pressure-volume diagrams. These diagrams are used in making engineering calculations for determining mean effective pressure and indicated horsepower. This type of instrument requires an indicator reducing motion not easily arranged for on modern compressor units: Thus an operator would be required to rely on a pull card mechanism which is quite unhandy and inaccurate when operated by hand.

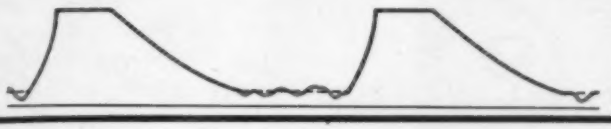
The chronomatic engine indicator shown here eliminates the need of an indicating reducing motion. This indicator, besides being used for engineering purposes, is ideal for taking a pressure-time indicator card which can readily be used to show the interior condition of a compressor cylinder for maintenance purposes.

The pressure record of the indicator is made on a removable chart wrapped around the chronomatic drum. Operation of the drum is simple and requires no skill or special training. The drum is free rotating and receives propulsion from a helical spring encircling the drum shaft. The drum is designed so that as it continues to spin, a uniform speed is obtained for sufficient time to produce a diagram with a constant time scale. The drum surface speed, in feet per minute, at any instant is indicated by the speed indicator on top of the drum.



PERFECT CARD

Figure 1. Good operating condition.

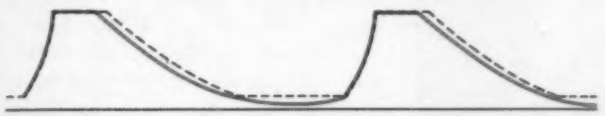


SUCTION VALVE CHATTERS

Figure 2. May be caused by weak valve springs, could result in broken valve plate or leaky valve.

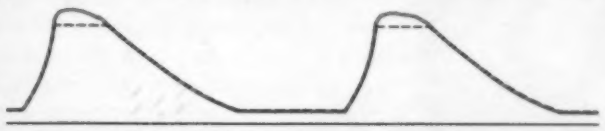
DISCHARGE VALVE CHATTERS

Figure 3. Weak discharge valve spring, will result in broken valve plate or leaky valve; cylinder heating and loss of horsepower may follow.



SUCTION PASSAGE TOO SMALL

Figure 4. Suction passages too small or valve lift insufficient.

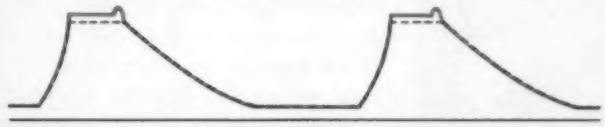


DISCHARGE PASSAGE TOO SMALL

Figure 5. Discharge passages too small or valve lift insufficient.

SUCTION VALVE SPRING TOO STIFF

Figure 6. Loss of horsepower may result; valve springs of proper tension should be installed.

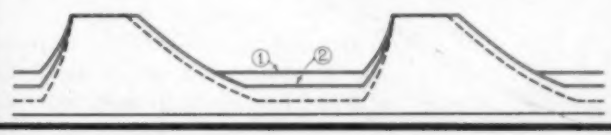


DISCHARGE VALVE TOO STIFF

Figure 7. Loss of horsepower may result; valve springs of proper tension should be installed.

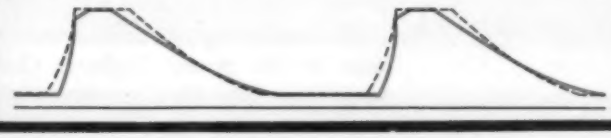
SUCTION VALVE LEAKING

Figure 8. Typical suction valve leak either in valve or gasket.



DISCHARGE VALVE LEAKING

Figure 9. Badly leaking discharge valve (curve 1) and slightly leaking discharge valve (curve 2); leak may be in valve or gasket.



PISTON RING LEAKING

Figure 10. May be the result of worn rings, out-of-round compressor cylinders or weak expander rings.

The pressure-time diagram shows the change of cylinder pressure on a time basis. As the chronomatic drum surface speed, read in feet per minute, can be adjusted over a broad range, the pressure record may be spread out on the chart over as much space as needed to obtain a clear picture of any portion of the compressor cycle to be studied.

To use the chronomatic engine indicator diagram, a set of pressure-time indicator cards has been developed to help the operator interpret the indicator card which may be taken in the actual operation of a compressor cylinder without any linkage with the engine. The guide indicator cards are shown in Figures 1 through 10.

ACKNOWLEDGMENT

This paper was prepared for presentation at the 33rd annual convention, NGAA, Baker Hotel, Dallas, April 21-23, 1954, by Earl Y. Palmer, The Atlantic Refining Company, Lovington, N. M.

—The End

PHOTOGRAPHER at his station in photographic plane. Oxygen mask is used for high altitude work only.

How Texas Gas Uses Photo Maps

The maps are easier and cheaper to make, and they aid maintenance crews by showing trees, populated areas—and even valve settings.

By J. E. THOMPSON, Supervisor, Mapping and Surveying, Texas Gas Transmission Corporation, Owensboro, Ky.

BY SWITCHING from conventional alignment sheets to photomaps in 1951 Texas Gas Transmission Corporation has saved considerable money and engineering and drafting time. The maps, which have aerial photos right on the blueprints, simplify field surveys and line location; and, at the same time, speed the drafting of construction drawings. Moreover, the finished product is an almost ideal operational drawing, showing trees, access roads and even valve settings.

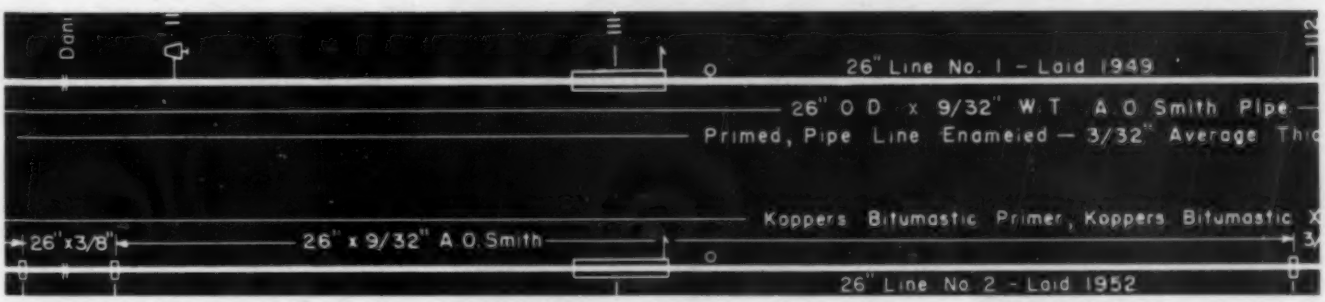
The decision to adopt the photo map system was spurred on by necessity. In the fall of 1951, the company started a new 184-mile stretch of 26-inch line in Louisiana at a time when the drafting room was still working on the as-built drawings of previous construction. In order to pick up a number of known, off-the-record relocations, the line was re-photographed (it had been photographed for location work) at the scale of 1:12,000—or about 1 inch = 1000 feet. The resulting photo mosaics were used to make up new planimetrics which proved to be highly accurate.

New procedure developed. This experience started a new train of thought. An aerial survey company was called in, and a procedure was worked out which resulted in the system of photomaps now used. This location map has topography shown in photographic form, economically printed on blueprint paper. This system is largely replacing the planimetrics, since it furnishes all the information given by the former, plus a great deal more in the pictorialization of the country itself, with its topography and culture in complete and accurate detail.

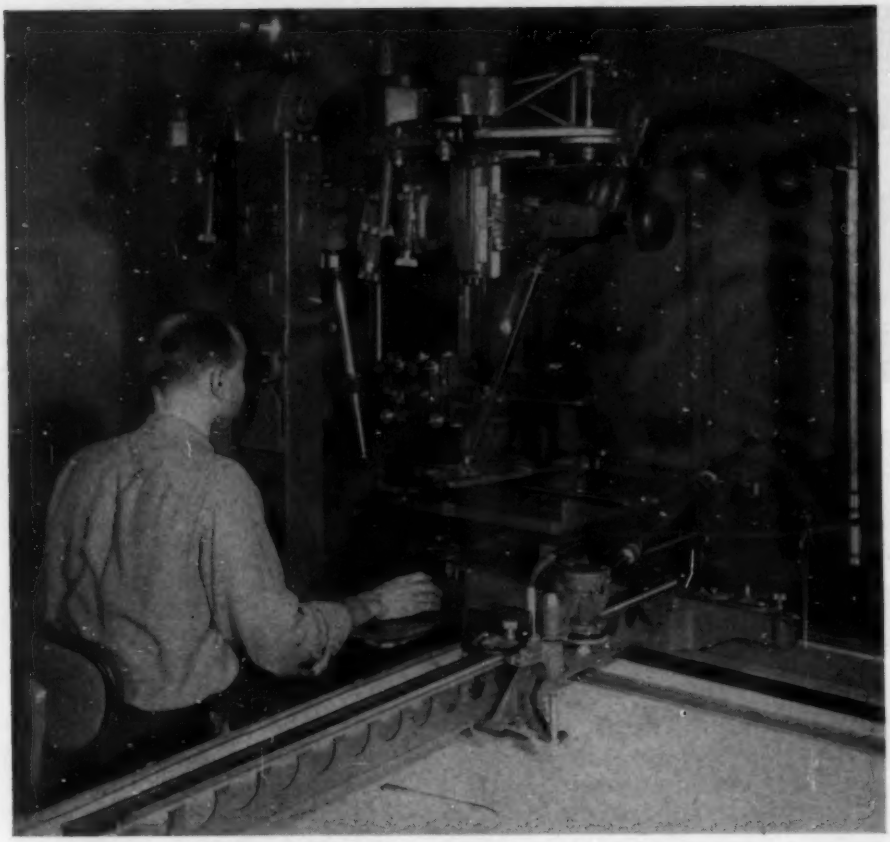
Later in 1952, construction of some 360 miles of 26-inch loop along the original main line was completed and new photography, 1:12,000, was made of this portion, along with some of the original single 26-inch installation. With this photography, the photomap system was set up as a definite program and it has expanded steadily since. Costwise, experience shows that the photomapping system runs only 80 percent to 90 percent of the cost of the planimetric system previously in use. The use value is easily 100 percent higher than the old. **At present this company has better than 1200 miles of line photographed after construction for the photomapping program.**

Photomapping has been used in the past by the Army Engineer Corps, some State Highway Departments and several transmission companies. Profiting by their experiences and adding modifications to suit the peculiarities of its own line, Texas Gas has developed what promises to be a very satisfactory system of record maps, at a reasonable cost.

So far, the company has been primarily concerned with development of relatively complete record maps to fill an inherited deficiency, and to do


26" Line No. 1 - Laid 1949
26" O D x 9/32" W.T A.O Smith Pipe
Primed, Pipe Line Enameled — 3/32" Average Thic
Koppers Bitumastic Primer, Koppers Bitumastic
26" x 3/8"
26" x 9/32" A.O.Smith
26" Line No. 2 - Laid 1952

A PORTION OF A TEXAS GAS AERIAL ALIGNMENT SHEET. Note that the farm roads, trees, and buildings are shown in the center portion, which is a photographic mosaic printed up on a base map. This map also serves to record preliminary and permanent surveys and alignment. The dotted lines in the photo represent other companies' pipe lines.



SANTONI STEREOCARTOGRAPH used in plotting precise contours in topographic maps. Pairs of stereo pictures are used to determine heights.

PHOTOGRAPHER checks lens of aerial camera before take-off on an aerial mapping mission.

this in fairly short order without excessive expense. Experience indicates that the same sort of maps can be used in construction and preconstruction stages to effect substantial savings. Plans have been made to make full use of photomaps on the next construction.

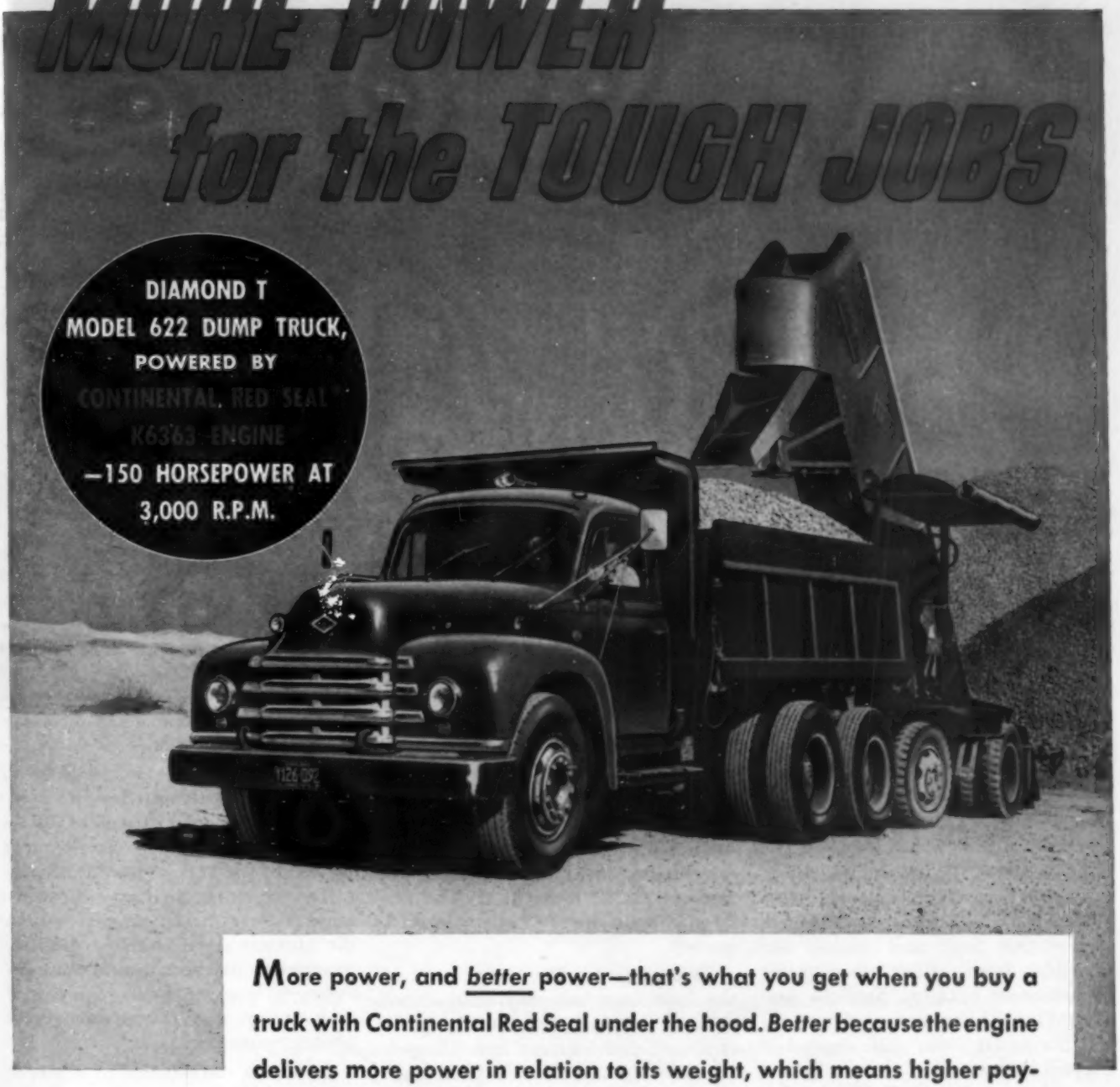
Photomaps show all details. Photomaps are particularly well adapted to the requirements of the operation of a gas transmission line. At a scale of 1:12,000 or 1 inch = 1000 feet, the details is perhaps at an optimum. Roads, fence lines, buildings, streams, wooded areas are all easily defined. Likewise at this scale, with a photo image strip eight inches or more wide across the sheet, there is a good three-quarters of a mile of topography shown on each side of the line location, which is ample to answer most of the questions which arise. Photography at 1:12,000 taken just after construction gives complete stereoscopic coverage of every spot on the line as it actually was installed; and with a two-power stereoscope it is even possible to spot block valve and blow-off locations. In addition, good enlargements can be made to a scale of 1 inch = 200 feet of any location on the line. This has proved to be an advantage a number of times.

Much field work eliminated. Preliminary reconnaissance for meter lot locations and cathodic-protection installations has been done in the office with the stereoscope, eliminating considerable field work, and saving much time. For the operation man in the field, the advantage of having a photographic map is incalculable. He does not have to work with symbols and scales since he has a photo of the installation. It helps the man at the drafting board by making it easier to reconcile obscure property descriptions to natural features, and it saves the time previously required to draw in topo features.

Also it provides the reassurance of knowing positively where the line is located with respect to all land features, with no possibility of a surveying error creeping in, such as using a left deflection when there should be a right deflection.

As for the technical specifications of the maps themselves, a standard sheet size of 24 inches by 36 inches

MORE POWER for the TOUGH JOBS



More power, and *better* power—that's what you get when you buy a truck with Continental Red Seal under the hood. *Better* because the engine delivers more power in relation to its weight, which means higher payload capacity. Better, too, because the output is delivered at engine speeds conducive to fast over-the-road travel with a minimum of shifting. For the really tough jobs, choose a truck with a power plant that's *built* for the tough jobs and backed by engine experience dating from 1902.

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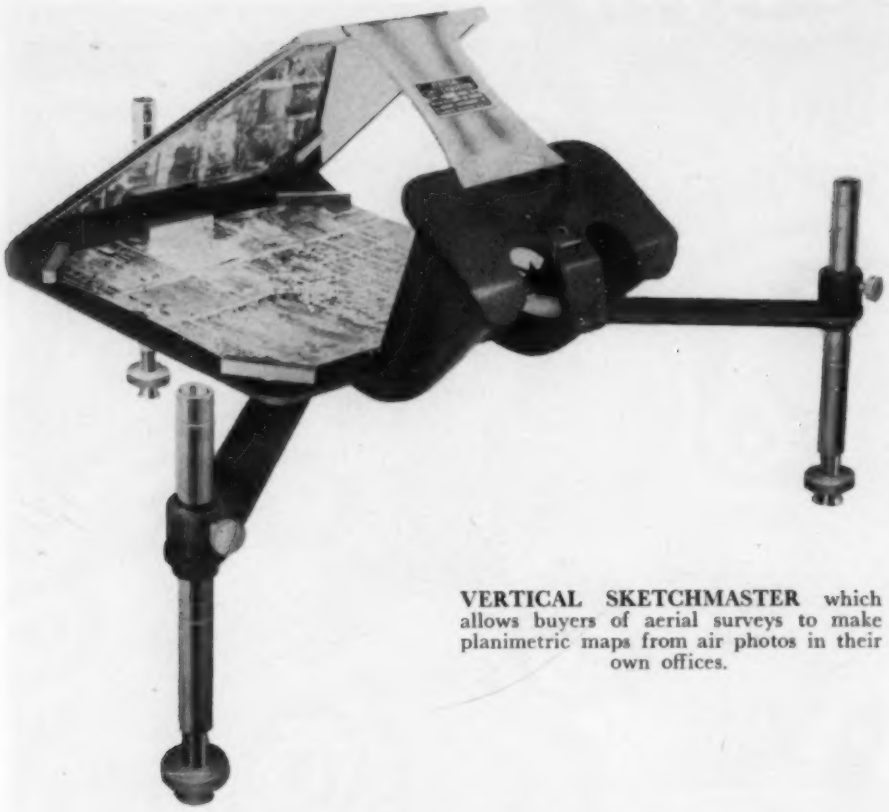

VERTICAL SKETCHMASTER which allows buyers of aerial surveys to make planimetric maps from air photos in their own offices.

was selected along with a scale of 1 inch = 1000 feet for all lines except extremely short laterals. Standard aerial film being 9 inches by 9 inches, the photo image of the strip averages out about 8 inches-plus, after mosaicing and smoothing out the edges.

The photography is made as closely as possible to a scale of 1:12,000 (1 inch = 1000 feet) and mosaics are assembled from contact glossy prints on masonite backing. Straight line control is used to maintain alignment, and horizontal linear scale control is effected by use of the rechain figures along the pipe line itself. The reader will bear in mind that the discussion here is on record maps designed to show where the pipe line actually is located. The mosaics, laid in strips about 34 inches long, are copied as negatives onto a matte film.

The strip image is located on the 24-inch by 36-inch copy film to leave proper space above for ownership notes and space below for construction history. This copy step may or may not include a format of a blank drawing sheet with common marginal data. In fact, for accurate final margin dimension, it is better to omit the marginal outline in the film copy, due to the projection up or down to obtain linear scale. The marginal notes are added on the drawing board along with other notes.

Work proves highly accurate. The control involved is not extensive nor complicated but is sufficient for the purpose and is economical. The finished prints usually scale within 1 percent.

Processing the film copy is one of the most important steps in our procedure, because the detail, grain structure and contrast are all governed by the fact that the photomaps will usually be printed on blueprint paper rather than photographic paper. Proper processing techniques require considerable research and experimentation in the photo lab. Several companies have worked out the process independently of one other; so it is not an exclusive process. (Incidentally, a negative which prints as well as a blue print will also give an excellent photographic print, when desired quality justifies the additional cost.)

Drafting notes can be added to the film negatives with a mixture of india ink and acetone. Six to eight drops of acetone per three-fourth ounce bottle is about right. There are various commercial inks available for working on film, though the india-acetone mixture is fairly satisfactory. Our drafting office is still experimenting with various mixtures of ink and opaquing fluid to find a more suitable product.

Prints are made on standard blueprint paper, with best photographic tones coming from the slowest speed papers. Faster printing papers usually give too much contrast.

The entire photomapping program is still in a state of development and better results will eventually be obtained. However, if the maximum quality obtainable should turn out to be just equal to the present product, photomapping would still be preferable to the previous planimetric map.

Aerial Maps Are Outstanding. Some companies run precise surveys of completed installations, tying-in to the Coast and Geodetic control system and to State co-ordinates, ending up with a highly accurate set of record maps in planimetric form. But such a map cost three to six times that of photomaps. All property lines traversed must be surveyed and reconciled to filed descriptions, and the right-of-way limits are monumented for fixing within the properties.

This is a desirable record to have, since it not only satisfies the company's requirements, but also aids in the long range economic development picture of the area. An accurately located line through what is often remote country will be of great help in the ultimate stabilization of property boundaries. Balanced against these advantages, however, is the high cost of such surveys and the advantages of photographs in field use.

Perhaps a combination of a precise survey with photographic printing would be the best solution to the mapping problem. However, this company feels that in view of the combined circumstances affecting it at this time, the most practical approach to its own problem is to obtain a reasonably accurate set of record maps as rapidly as possible through the use of the photomapping system, without an elaborate survey. Although it makes no great contribution to the long range, large area surveying problem, it does more than satisfy the company's needs.

—The End

ACKNOWLEDGMENT

The author wishes to express appreciation to Abrams Aerial Survey Corp., Lansing, Mich., for the use of photos and aerial maps.

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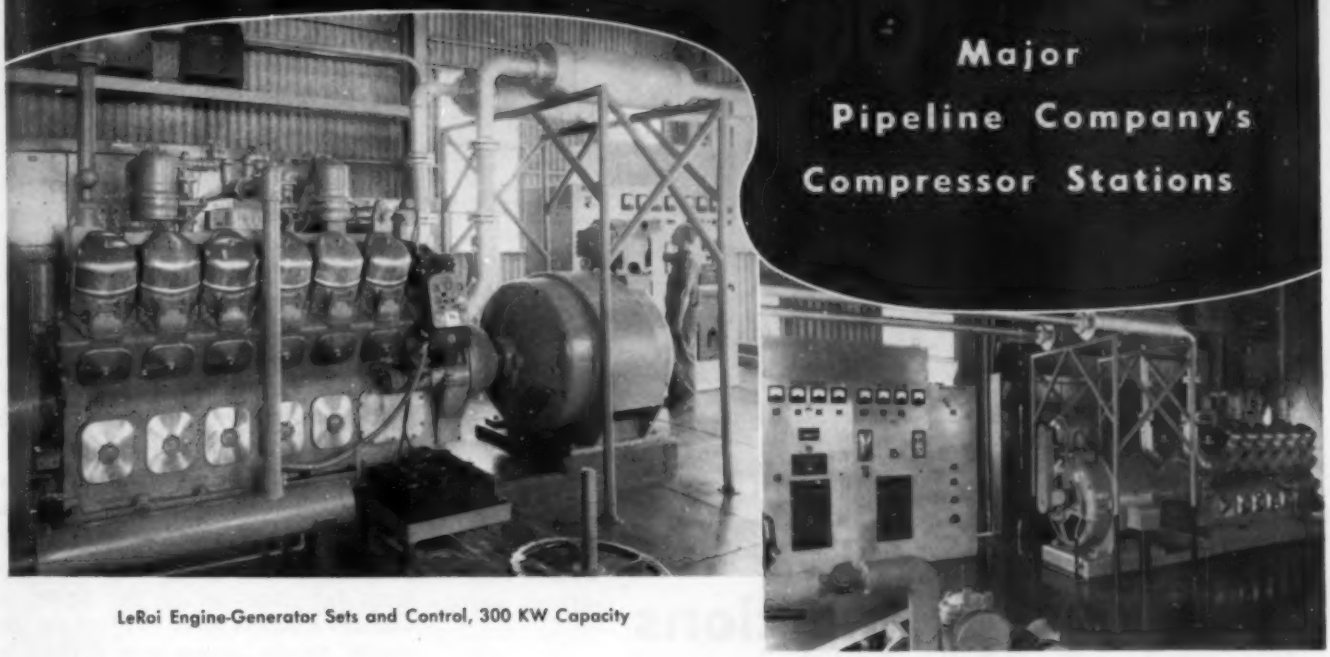

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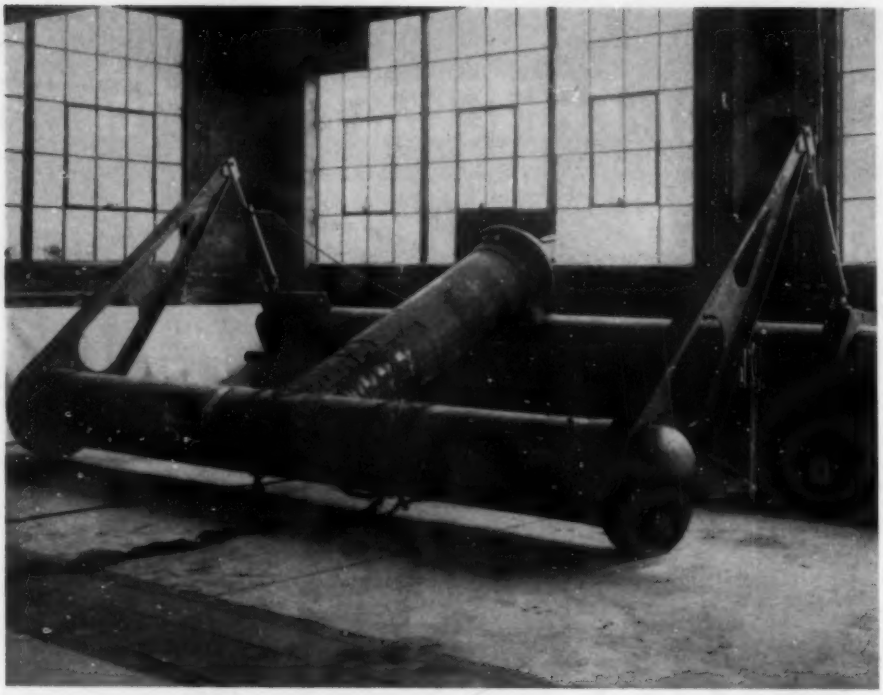


Figure 1. Traverse-bend tests were applied to 24-inch branch connection. Pipe was API 5LX with a minimum yield strength of 52,000 pounds per square inch. Wall thickness was 0.312 inch.

How Stresses Are Affected By Branch Connections

For more than a year Battelle Memorial Institute has conducted research on design of unreinforced pipe line branch connections. Here is the result.

By E. D. ABRAHAM, Research Engineer, and
G. M. McCLURE, Assistant Chief,
Applied Mechanics Division, Battelle Memorial Institute

A RESEARCH PROGRAM to provide basic information on the stresses in pipe line branch connections was started at Battelle Memorial Institute two years ago by a group of five pipe line companies. Over the past year and a half the program has consisted of a study of unreinforced connections. This is a report on progress of this research.

During the coming year, the work will be continued under the sponsorship of the American Gas Association. Studies will center around various sizes and types of reinforced connections.

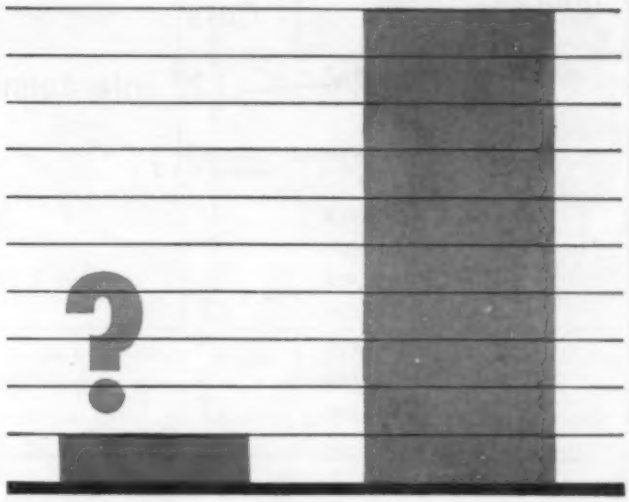
The objective of the past year's work was to provide basic information on the stresses in unreinforced connections of different sizes that could be used later for analysis of the effect of reinforcements. A large amount of data on the stress distribution of unreinforced connections under internal pressure and external loads was collected. These indicated the main weaknesses of unreinforced connections. The coming year's work will include experimental stress analysis of reinforced connections. It is expected that the over-all program will provide an evaluation of various types of reinforcements for different sizes of branches, and design data which a pipe line engineer can use to predict reasonably well the stresses in a reinforced connection in terms of internal pressure and external loads.

The past year's work may be described in two phases. First, strain-gauge measurements were made on seven branch connections in the field. Second, tests on unreinforced connections were performed in the laboratory. These made up the major portion of the program.

Field work. The first phase, that of the field tests, was carried out during the summer of 1952 in the Toledo-Detroit area on a 26-inch diameter line owned by Panhandle Eastern Pipe Line Company. During the course of some work that was carried out by Panhandle Eastern, it was found advisable to cut several underground interconnections between two of its parallel main lines. This presented an opportunity to determine the loads that existed on these branch lines. Electric-resistance strain gauges were applied to seven of the interconnections, and readings were taken both before and after each interconnection was cut. In this manner, the loads that had existed on the branch lines were determined.

Figure 2 shows a typical plan view of the interconnections from which the measurements were taken. Although all seven of the connections were not identical to this figure, it will nevertheless serve to illustrate the results. Strain gauges were applied at Section AA′ after the interconnection had been uncovered. A total of eight strain gauges were used—one every 45 degrees around the circumference of the pipe. These were applied in the longitudinal direction in order that they would measure longitudinal strains. A first reading on the gauges was obtained before the pipe was disturbed. Then, the interconnection and bypass pipes were cut, and another reading was obtained from the gauges. From the difference between the two readings, the stress that had existed in the pipe was determined. Analysis of these stresses indicated that the most prominent loads at each location were bending, and that the axial forces were very small. The bending moments, computed from the stresses, are summarized in the bottom half of Figure 2 for each of the seven interconnections. The moment in foot-pounds that existed on the branch at the gauge locations and the direction of the moments at each interconnection are given. As can be seen, both the magnitude and direction of the bending loads were varied. These loads could have been caused either at the time of construction or

How much should you spend for valve maintenance?



In all but the most simple services, *any* kind of valves need *some* maintenance.

Of course the same thing is true with any mechanism where metal rubs metal. Take your car, for example. You lubricate the engine to *reduce* maintenance and save major repair bills. If you don't lubricate it, you save a few dollars on lubricant, but pay the far, far higher costs of part replacement. More important, you'll need a new car much oftener.

Exactly the same principle applies to valves. If you install Nordstrom lubricant-sealed valves, maintenance is generally confined to adding lubricant at intervals. You lubricate to *reduce* maintenance—to avoid the high costs of major repairs, new parts, and shorter valve life. That's the big advantage of Nordstrom valves in the first place.

Over a 20-year period, Nordstrom sales of repair parts have been less than half of one per cent of sales. In several plants in which records were kept and where Nordstrom and other valves were used, repair parts for Nordstrom valves ran about one-tenth of other makes.

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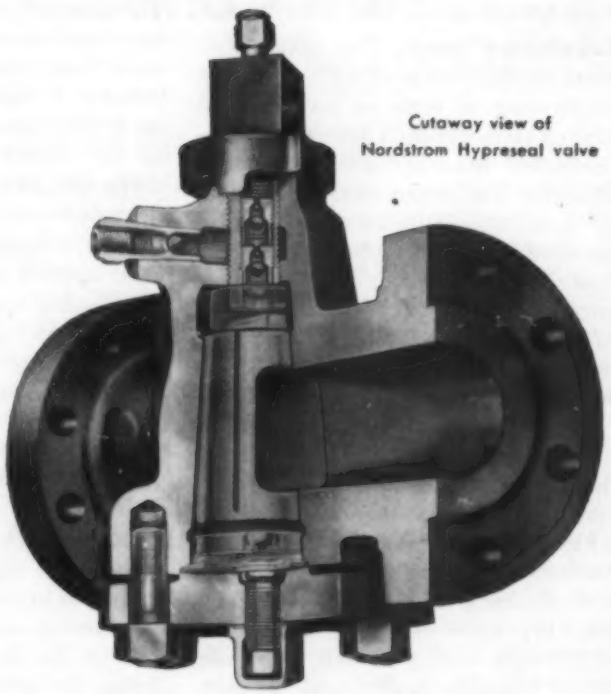
So, don't be misled . . .

Valve lubrication doesn't *cost* money, it *saves* money. If you'd like to discuss the application of Nordstrom valves for any service, call your Nordstrom representative or write Rockwell Manufacturing Company, Pittsburgh 8, Pa.



Cutaway view of Nordstrom Hypreseal valve

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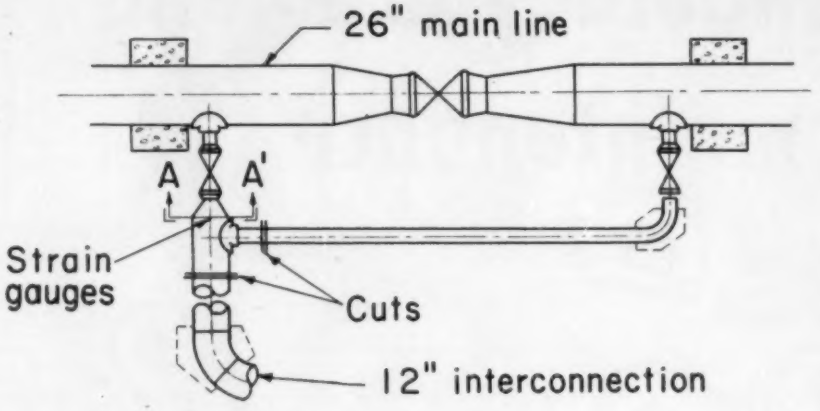

Interconnection No.	Bending Moment at A-A', ft-lb	Direction of Bending at A-A'
1	4,200	
2	12,700	
3	20,400	
4	13,200	
5	18,600	
6	19,000	
7	37,200	

Figure 2. Field measurements.

as a result of temperature changes, back-fill settlement, etc.

Laboratory work. The major portions of the year's effort was in the performing of tests on unreinforced branch connections. Three sizes of unreinforced branches all on 24-inch-diameter pipe were constructed. All of these were subjected to internal pressure and two different bending loads on the branch. Electric-resistance wire strain gauges were used on each connection to determine the stress distributions under the three loading conditions.

Figure 3 summarizes the connection sizes and the tests performed. All three of the connections had 24-inch-diameter headers manufactured to API5LX specifications with a minimum yield strength of 52,000 psi. The wall thickness was 0.312 inch. The branches were 4-inch, Schedule 40 (0.237-inch wall); 12-inch, Schedule 20 (0.250-inch wall); and 24-inch pipe—the same pipe from which the headers were made. The external loads that were applied to the branch during the tests are represented in Figure 3 by F_t and F_v. Application of the load F_v parallel to the axis of the header was called the axial-bend test, and application of the load F_t perpendicular to the axis of the header was called the transverse-bend test. The internal pressure and bend tests were performed on all three connections, and combinations of internal pressure in each one of the bends, applied simultaneously, were performed on the 12-inch connection. Figure 1 shows the 24-inch connection during the transverse-bend test.

Electric-resistance strain gauges were applied to each connection in the shaded quadrants in Figure 3. Rosette-type gauges consisting of three separate elements with their axes 45 degrees apart were used. With this type of strain gauge, it is possible to determine the principal strains and principal stresses at the location of each gauge.

During each test, the strains from each gauge element were recorded at various increments of internal pressure and/or external load. In addition to the strain-gauge data taken during the pressure test, the over-all distortion of each connection when subjected to internal pressure was determined, and some measurements in the change in curvature in the pipe wall at critical locations were made. These curvature measurements were made in order that the strains on the inside of the pipe wall could be estimated.

After all of these tests had been completed, the burst strength of each connection was determined by increasing the internal pressure in each until failure occurred.

Results. The highlights of the data are summarized below. Included are the maximum stresses, the directions of principal stresses, and the over-all distortion of each connection under internal pressure.

In all of the tests, the region of high stress was a very narrow one adjacent to the intersection of the branch and header. These high stresses diminished rapidly within a short distance from the intersection weld, the distance varying from a few inches to about fourteen inches. Consequently, only the stress conditions next to the intersection between the branch and header will be given below.

Figure 4 shows a comparison of maximum stress next to the intersection for the 4-, 12-, and 24-inch branch connections subjected to internal pressure. The abscissa on this plot represents the position around the intersection. The ordinate is a ratio of the maximum principal stress observed to the nominal (Pd/2t) circumferential stress in the header. This method of plotting is used in order to afford a comparison to other plots of the stress conditions under external loads on the branches. In this and subsequent figures, the open circles indicate that the maximum stress was measured on the branch pipe next to the intersection weld, and the black dots indicate that the maximum stress was measured on the header next to the intersection weld. The main points of note in Figure 4 are the magnitude and position of the high stress on the 24-inch connection and the fact that the 12-inch and 4-inch connections' maximum stresses do not vary a great amount from one another.

Figure 5 is a similar plot of the stress conditions next to the intersection weld between the branch and the header during the transverse-bend test. Here also, the ratio of maximum principal stress observed to the nominal stress is plotted on the ordinate. This time, the nominal stress was taken as the highest bending stress calculated from the ordinary beam formula $s = Mc/I$. Here again, it is interesting to note that the 24-inch connection presents the worst case

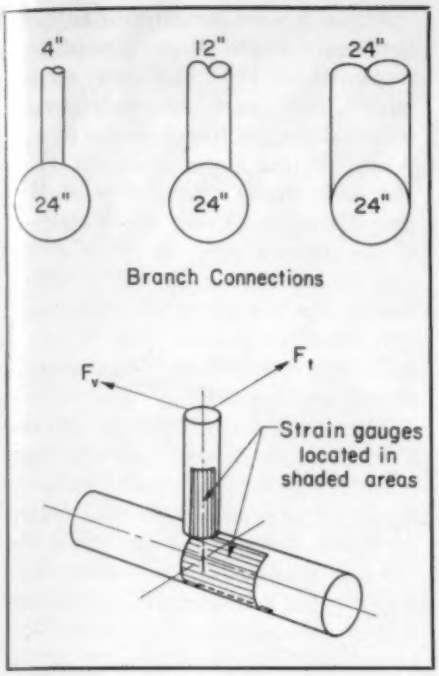

Figure 3. Branch-connection tests.

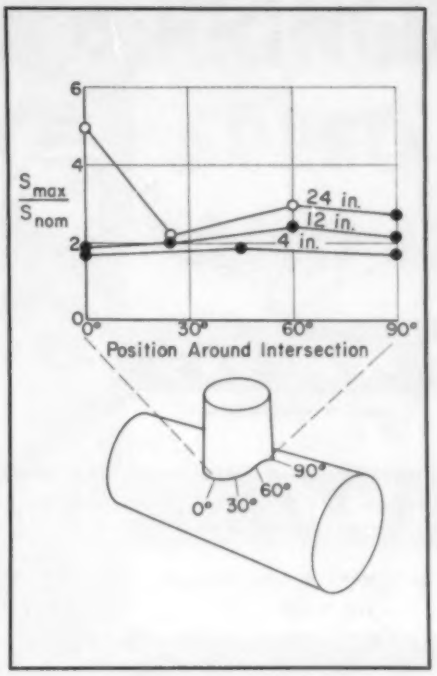

Figure 4. Ratio of maximum to nominal stress in internal-pressure test.

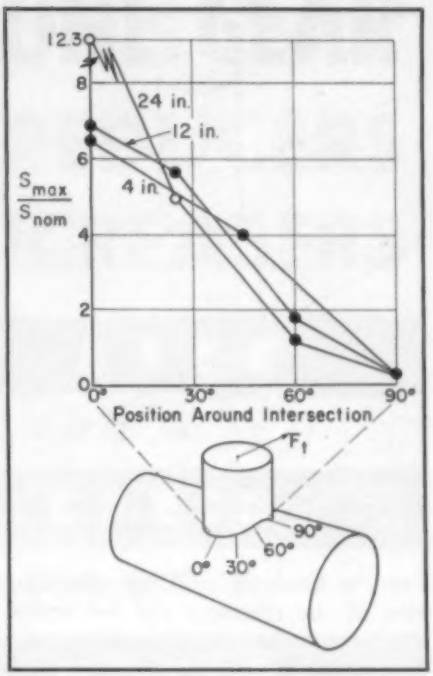

Figure 5. Ratio of maximum to nominal stress in transverse-bend test.

with the maximum stress also occurring at the zero-degree position. The relatively high ratios of maximum to nominal stress under this transverse loading are also significant.

Figure 6 is an identical plot for the stress conditions next to the intersection during the axial-bend test. The stresses in all of the connections under this loading are considerably less than in the transverse-bend tests, with the 24-inch connection still exhibiting the worst case.

It might be well to point out a precaution that should be observed in interpreting the data presented as they are in Figures 5 and 6. The ordinates in both figures are ratios of maximum stress to nominal stress in the branch pipe and are, therefore, directly proportional to the section modulus of the branch pipes. Actually, if the same axial or transverse force were applied to all three of the connections, the highest stresses would occur in the 4-inch connection and the lowest in 24-inch connection.

It should also be pointed out that the stress conditions presented in Figures 4, 5, and 6 are valid only up to the point at which the metal around the connection begins to yield.

All of the stresses depicted in Figures 4, 5, and 6 are the maximum principal stresses at the respective positions around the intersection of the branch and header. The directions of these stresses in each branch connection under internal pressure are shown in Figures 7, 8, and 9. It can be seen that, in general, the principal stress directions were parallel to the intersection welds. Note that, in several areas, a pure biaxial stress field exists as indicated by equal principal stresses.

To complete the picture of what occurs in a branch connection under internal pressure, measurements of the over-all distortion of the three connections were taken. Figures 10 and 11 show the relative distortion of various areas of the 24-inch and 12-inch connections, respectively. These schematic drawings are meant to only qualitatively show the amount of distortion.

After all of these tests in which the connections were subjected to internal pressure and external loads on the branch were completed, each of the connections was subjected to a burst test. The pressures at failure were as follows: 4-inch connection, 1970 psi; 12-inch connection, 1580 psi; 24-inch connection, 1620 psi. In the 4-inch and 12-inch connections, the fracture originated in the weld between the branch and header at the 90-degree position. In the 24-inch connection, the exact origin of failure could not be determined, since the fracture traveled adjacent to the weld from the zero-degree position to the 45-degree position before breaking out

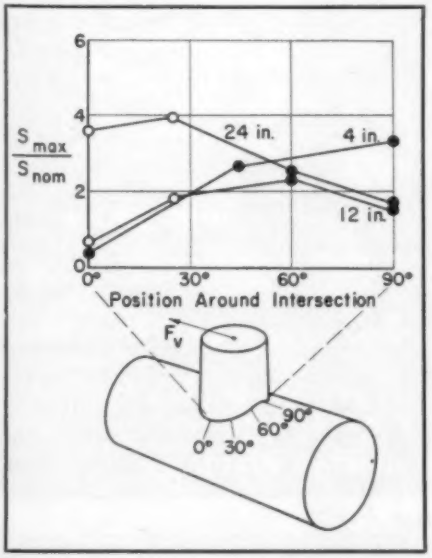

Figure 6. Ratio of maximum to nominal stress in axial-bend test.

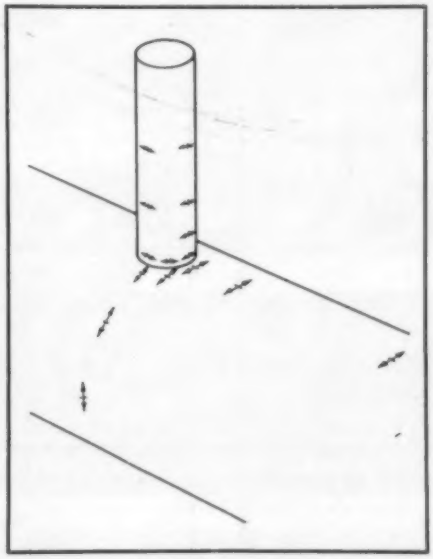

Figure 7. Principal-stress directions in a four-inch connection.

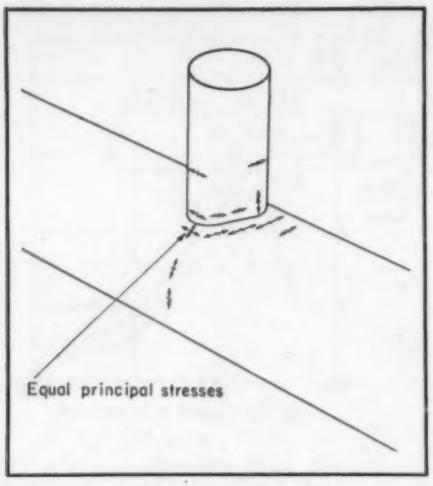

Figure 8. Principal-stress directions in a 12-inch connection.

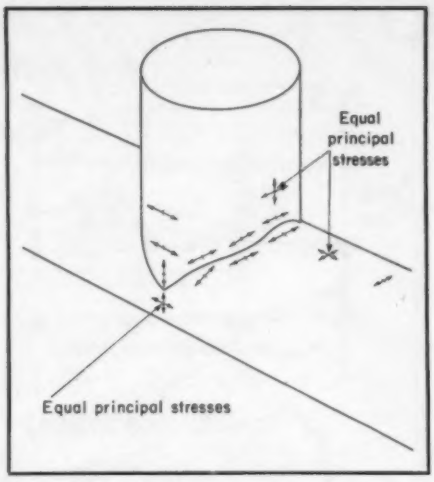

Figure 9. Principal-stress directions in a 24-inch connection.

into the header pipe. Close examination of the fractures did not reveal any reason for the 12-inch connection failing at a lower pressure than did the 24-inch one.

The most interesting and important observations that result from consideration of all of the results of the program on unreinforced connections may be summarized as follows:

1. Under internal-pressure loading, for a given pressure, the larger the branch-to-header diameter ratio the higher the maximum stress that was observed.
2. The region of high stress on all of the connections was a very narrow one next to the weld between the branch and header. These high stresses diminished rapidly within a short distance from the weld—in all cases, within one branch diameter of the weld.
3. Comparing the two external-load tests, for the same load in pounds at the end of the branch (approximately the same moment), the transverse bending in the branch produced higher stresses in each connection than did the axial bending.

The results of these data on unreinforced connections provide a basis for attacking the problem of reinforcements. An example of this can be seen by referring to the over-all distortion of the 24-inch connection under internal pressure in Figure 10. Note that the zero-degree section, where the maximum stress was found, tends to "bulge out" in the manner of a bubble. This suggests that if reinforcement of this area is to be effective, the reinforcement must have strength against bending in both the longitudinal and circumferential directions. In the 90-degree section, where there were also high circumferential stresses found on the header, it appears that a reinforcement should also have strength against bending in two directions. From the deflections of the branch pipe in Sections AA' and BB' of Figure 10, the cross section of the branch at 90-degree position tends to become oval. Effective reinforcement of the connection should prevent this.

These and other problems relating to the design of reinforcements will be explored in the work during the coming year under sponsorship of the American Gas Association. Although the specific details have not yet been entirely worked out, it is expected that the stress distribution around branches with a number of types of reinforcements will be determined. This will be done under the same loading conditions and with similar strain-gauge instrumentation as the unreinforced tests. Thus, the stresses for the various reinforced branches can be correlated with stress patterns on the unreinforced counterpart, and the effectiveness of the respective reinforcements related to the branch size can be determined. It is also expected that the data obtained will furnish design criteria from which stresses in a connection can be reasonably well predicted in terms of internal pressure and external loads.

ACKNOWLEDGMENT

From a paper presented at the annual short course in gas technology sponsored by the Southern Gas Association at Texas College of Arts and Industries, Kingsville, Texas.

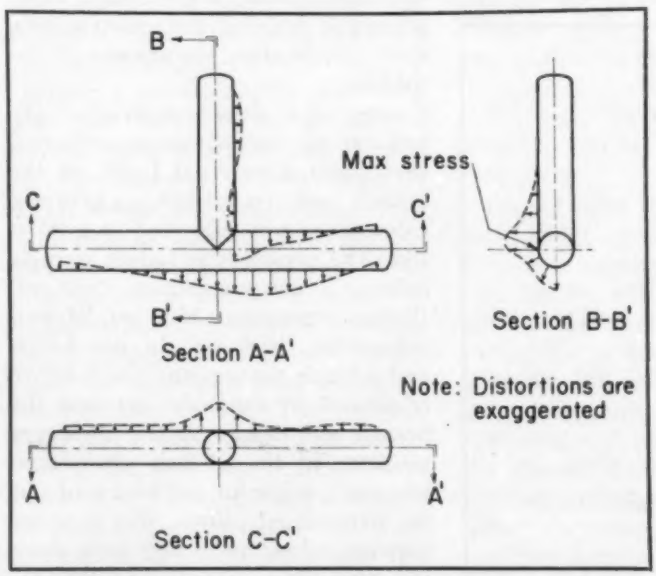

Figure 10. Distortion of 24-inch connection with internal pressure.

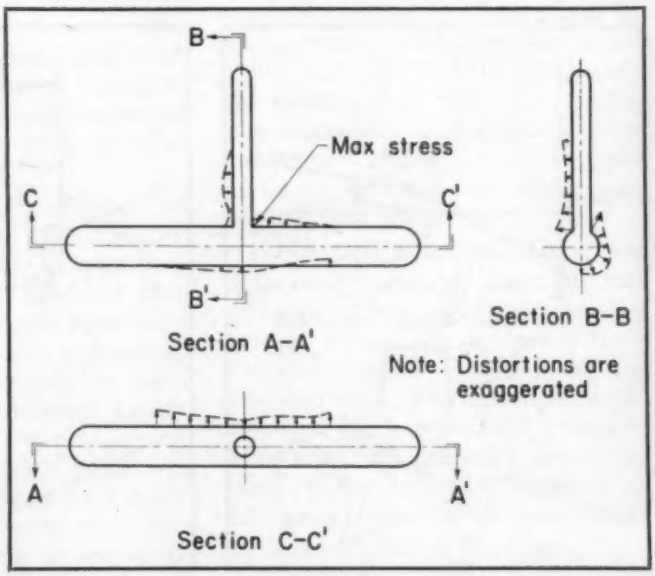

Figure 11. Distortion of 12-inch connection with internal pressure.

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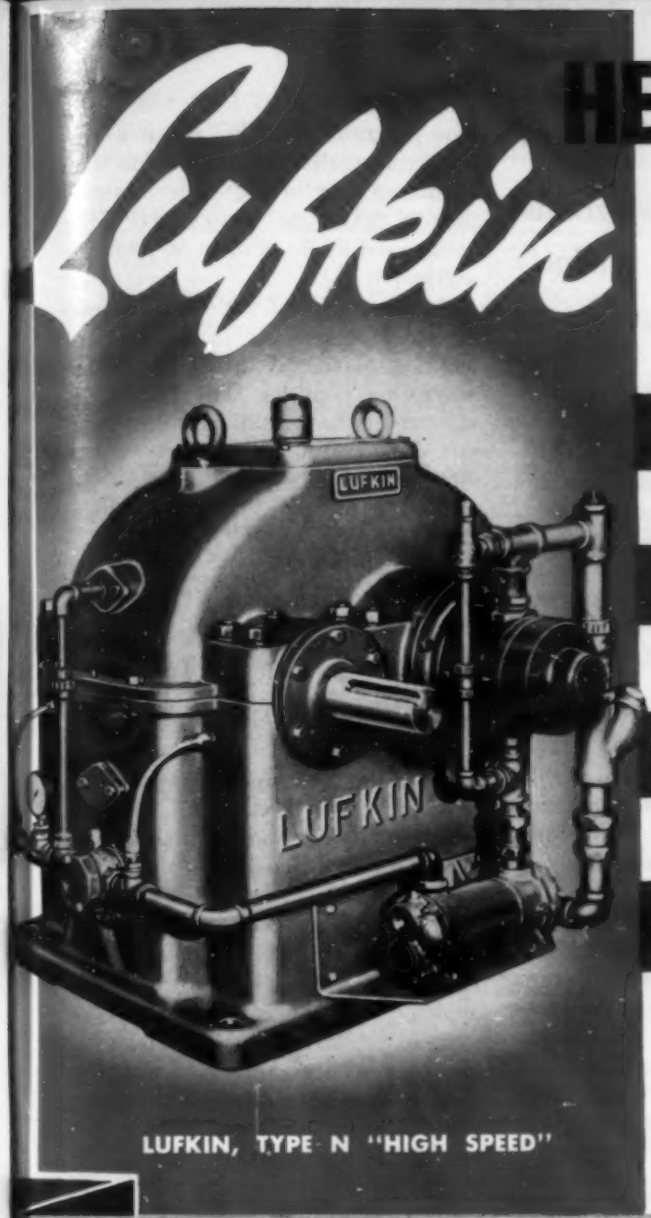

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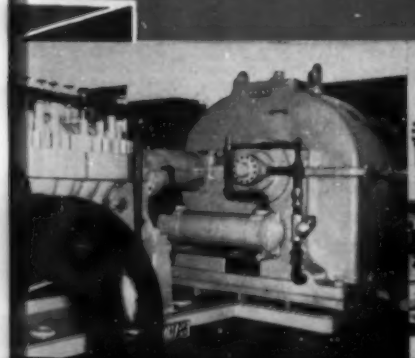

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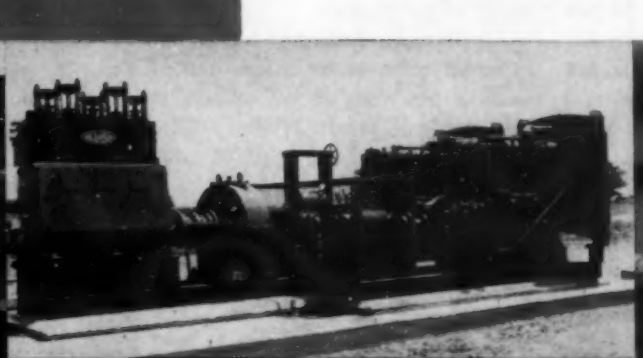

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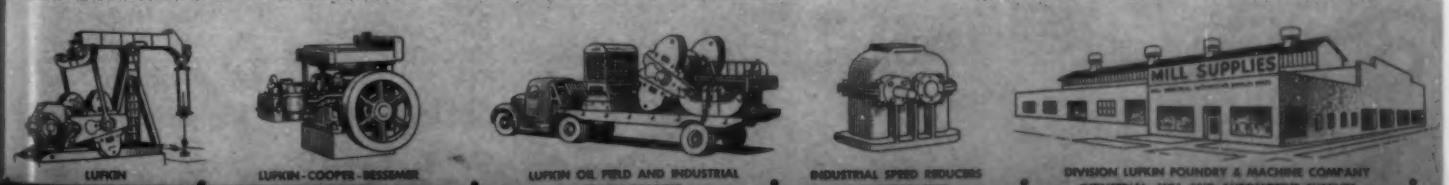

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Products Go Underground

Economics is the answer to why underground storage for LPG has now expanded to storage of jet fuels, gasoline, crude, chemicals and chemical charge stocks.

By G. H. BILLUE, Underground Storage Company, Wichita Falls, Texas

THE WIDE ACCEPTANCE of the underground storage of hydrocarbons since the first installation by Texas Natural Gasoline Company near Rankin in 1950 has opened up an entirely new concept to the production, manufacturing and sales of petroleum products, especially the light hydrocarbons.

The use of underground storage for LPG has now expanded to the storage of jet fuels, gasoline, crude, chemicals, and chemical charge stocks.

The storage in salt domes and beds has been expanded to mined cavities in shale and hard rock and to the development of wells in hydratable shales. This experimental well demonstrates that storage can be developed in shale formations and hydrocarbons have been stored and recovered without storage loss.

Underground storage is being developed in salt formations for $1 per barrel and in excavated cavities for less than $5 per barrel vs. $10 per barrel for steel butane storage and $20 per barrel for steel propane storage. These construction costs now make it economically sound to "save and sell" LPG.

LPG has an average value of 4 cents per gallon or $1.68 per barrel; therefore, underground storage will about pay for itself each year and return $1 per barrel profit.

Up until 1951 each year LPG became a glut on the market in the summer and during the winter the retail customers could not be supplied.

With the increase in LPG storage the price fluctuation was stabilized and products were made available to the customers. Manufacturing facilities were expanded in 1952 and 1953 with additional underground storage, and with the relative mild winters there is an apparent long supply of LPG products; however, all storage was utilized during the winter of 1953.

The use of underground storage has been profitable to both the marketer and the producer. It has enabled the producer to even out and economically store off peak products which would be otherwise lost through flaring of product or curtailment of production.

Underground storage has increased railroad revenue by an estimated $1 million per year in off season hauls and hauls of products that otherwise would be flared at point of production.

Since additional production and most important storage facilities are being developed the distributor now can let loose full selling force to obtain additional LPG customers. The potential for LPG use is a long way from realization since it has been estimated that in the central eastern part of the United States LPG is not being used by 80 percent of potential users.

As to the type of underground storage selected, much depends upon the location of the production and/or marketing facilities. The largest developments have been in the areas of salt domes and salt beds near production facilities. Other areas which offer favorable possibilities are those which have sedimentary, granitric or plutonic formations for mined cavities and sedimentary formations for injection in porous rocks.

The washed-out salt bed is the most popular type. These favorable saline areas are found in Texas, New Mexico, Kansas and Oklahoma as well as parts of Michigan, Ohio, Pennsylvania, New York and West Virginia. Salt domes along the Gulf Coast of Texas, Louisiana and Mississippi have been utilized extensively for storage.

Mined shale caverns are the next most popular type of storage. These are found in Texas, Oklahoma, Arkansas, Illinois and Ohio. Partially depleted gas reservoirs account for some of the larger underground facilities and even abandoned mines or tunnels have been considered and are being used for LPG storage.

Most of the underground storage has taken place near the production facilities. However, the real need is for storage in market areas.

The capacity of underground storage is increasing so rapidly that any listing becomes out-of-date the day after it is compiled. Present estimates for LPG indicate that 9 million barrels have been completed and that the ultimate planned capacity is close to 14 million barrels. —**The End**

Status of LPG Underground Storage Projects

January, 1954

COMPANY	Type Company	Location of Underground Storage	Completion Date	Type Storage	Capacity—Barrels		Remarks
					Ultimate	Present	
Anchor Gasoline Corporation	Producer	Midland, Texas	June, 1952	Salt Layer	30,000	.....	Propane
Anchor Gasoline Corporation	Producer	Midland, Texas	August, 1952	Salt Layer	30,000	.....	Butane
Anchor Gasoline Corporation	Producer	Midland, Texas	Fall, 1952	Salt Layer	30,000	.....	Propane
Anchor Gasoline Corporation	Producer	Midland, Texas	Fall, 1952	Salt Layer	30,000	.....	Mix
Anchor Gasoline Corporation	Producer	Martin Co., Texas	.....	.....	200,000	.....	4-50,000 bbls.
Anchor Gasoline Corporation	Producer	Bath, N.Y.	.....	.....	150,000	.....	.....
Anchor Gasoline Corporation	Producer	Hattiesburg, Mississippi	.....	.....	240,000	.....	.....
Anchor Gasoline Corporation	Producer	Near Midland, Texas	.....	.....	480,000	.....	.....
Antlantic Refining Co.	Producer	Denton, Lea, Texas	.....	.....	50,000	.....	.....
Barnhart Hydrocarbon Corp.	.....	Reagan Co., Texas	.....	.....	24,000	.....	Mix
Barnhart Hydrocarbon Corp.	.....	Reagan Co., Texas	.....	.....	95,000	.....	Propane
Chicago Corporation	Producer	Carthage Field, Texas	.....	.....	.....	50,000	Propane
Cities Service Oil Co.	Producer	Burton, Kansas	Fall, 1952	Salt Layer	100,000	.....	Propane
Cities Service Oil Co.	Producer	Detroit, Michigan	Spring, 1952	Salt Layer	100,000	.....	Propane
Cities Service Oil Co.	Producer	Lowell, Michigan	August, 1951	Salt Layer	100,000	100,000	Propane
Cities Service Oil Co.	Producer	Pampa, Texas	Spring, 1953	Salt Layer	100,000	.....	Propane
Cities Service Oil Co.	Producer	Hutchinson, Kansas	.....	.....	100,000	.....	4-25,000 bbls.
Continental Oil Co.	Producer	Big Lake, Texas	.....	.....	25,000	.....	.....
Continental Oil Co.	Producer	Reagan Co., Texas	.....	.....	50,000	.....	.....

Continued on Next Page

Status of LPG Underground Storage Projects

January, 1954

(CONTINUED FROM PRECEDING PAGE)

COMPANY	Type Company	Location of Underground Storage	Completion Date	Type Storage	Capacity—Barrels		Remarks
					Ultimate	Present	
Dow Chemical Co.	.....	Brazoria Co., Texas	.....	.....	.....	.....	.....
Ellis Transport Corp.	.....	Harris Co., Texas	.....	.....	.....	.....	.....
El Paso Natural Gas Co.	Producer	Jal, New Mexico	.....	Slat Bed	100,000	.....	.....
El Paso Natural Gas Co.	Producer	Reagan Co., Texas	.....	.....	.....	.....	.....
Enterprise Petroleum Gas Co.	Distributor	Hanesville, Texas	Summer, 1952	Salt Dome	25,000	25,000	Mix
Enterprise Petroleum Gas Co.	Distributor	Hanesville, Texas	Spring, 1953	Salt Dome	50,000	.....	Mix
Freestone Underground Storage Corp.	LPG Dealer	Freestone Co., Texas	Summer, 1952	Salt Dome	35,000	.....	Propane
Freestone Underground Storage Corp.	LPG Dealer	Freestone Co., Texas	Summer, 1952	Salt Dome	35,000	.....	Butane
General Gas Corp.	Distributor	Gibsland, Louisiana	August, 1951	Salt Dome	100,000	80,000	Mix
General Gas Corp.	Distributor	Gibsland, Louisiana	Summer, 1951	Salt Dome	100,000	30,000	Propane
General Gas Corp.	Distributor	Edwards, Mississippi	Fall, 1951	Salt Dome	100,000	.....	Propane
General Gas Corp.	Distributor	Hattiesburg, Mississippi	Spring, 1952	Salt Dome	100,000	.....	Propane
General Gas Corp.	Distributor	Hattiesburg, Mississippi	Spring, 1952	Salt Dome	100,000	.....	Mix
Gulf Oil Corporation	Producer	Eunice, New Mexico	Spring, 1951	Salt Layer	50,000	10,000	Propane
Gulf Oil Corporation	Producer	Jefferson Co., Texas	Spring, 1952	Salt Layer	100,000	.....	Refinery Product
Gulf Oil Corporation	Producer	Crane Co., Texas	.....	Salt Layer	30,000	.....	.....
La Gloria Corporation	Producer	Texas	.....	Gas Sand	100,000	.....	.....
Lion Oil Company	Producer	Diamond "M"-Sharon Ridge	Summer, 1952	Salt Layer	225,000	36,000	Propane
Lion Oil Company	Producer	Diamond "M"-Sharon Ridge	Fall, 1952	Salt Layer	225,000	31,000	Butane
Lion Oil Company	Producer	Diamond "M"-Sharon Ridge	.....	.....	225,000	36,000	Propane and Butane
Lion Oil Company	Producer	Diamond "M"-Sharon Ridge	.....	.....	.....	.....	.....
Magnolia Petroleum Co.	Producer	La Gloria Field, Texas	.....	.....	.....	.....	.....
Magnolia Petroleum Co.	Producer	Seeligson Field, Texas	.....	.....	.....	.....	Propane
Magnolia Petroleum Co.	Producer	Hull Field, Liberty Co., Texas	.....	.....	.....	.....	.....
Missouri Hydro Gas Co.	Distributor	Springfield, Missouri	Fall, 1951	Mined Limestone	25,000	25,000	Mix
National Co-op Refinery	Producer	McPherson, Kansas	Summer, 1952	Salt Layer	50,000	50,000	Mix
National Petrochemicals Co.	Producer	Tuscola, Illinois	July,1954	Mined Shale	170,000	.....	Propane
Panoma Gasoline Co.	Producer	Carson Co., Texas	.....	.....	35,000	.....	.....
Phillips Petroleum Co.	Prod.-Dist.	Borger, Texas	Fall, 1951	Salt Layer	55,000	55,000	Propane
Phillips Petroleum Co.	Prod.-Dist.	Borger, Texas	Spring, 1952	Salt Layer	55,000	55,000	Propane
Phillips Petroleum Co.	Prod.-Dist.	Borger, Texas	Fall, 1952	Salt Layer	50,000	.....	Propane or Butane
Phillips Petroleum Co.	Prod.-Dist.	Goldsmith, Texas	Fall, 1952	Salt Layer	200,000	.....	Deethanized Product
Phillips Petroleum Co.	Prod.-Dist.	Kankakee, Illinois	March, 1953	Mined Shale	400,000	.....	Propane
Phillips Petroleum Co.	Prod.-Dist.	Spraberry, Texas	.....	Salt Layer	100,000	.....	Propane or Butane
Phillips Petroleum Co.	Prod.-Dist.	Upton Co.-Rankin, Texas	.....	Salt Section	400,000	.....	.....
Phillips Petroleum Co.	Prod.-Dist.	Moore Co., Texas	.....	.....	.....	.....	Ammonia
Pure Oil Co.	Prod.-Dist.	Jal, New Mexico	Spring, 1952	Salt Layer	75,000	70,000	Propane
Pure Oil Co.	Prod.-Dist.	Jal, New Mexico	Summer, 1952	Salt Layer	75,000	.....	Propane
Pure Oil Co.	Prod.-Dist.	Dollarhide Field, Texas	.....	.....	75,000	.....	Propane
Pure Oil Co.	Prod.-Dist.	Dollarhide Field, Texas	.....	.....	75,000	.....	Propane
Reef Fields Gasoline Co.	.....	Howard County, Texas	.....	Salt Section	150,000	.....	3-50,000 bbls.
Reef Fields Gasoline Co.	.....	East Vealmoor, Borden	.....	.....	500,000	150,000	Propane and Butane 10-50,000 bbls.
Richardson, Sid, Gasoline Co.	Producer	Kermit, Texas	Summer, 1950	Salt Layer	100,000	110,000	Propane
Richardson, Sid, Gasoline Co.	Producer	Kermit, Texas	Summer, 1951	Salt Layer	100,000	58,000	Butane
Richardson, Sid, Gasoline Co.	Producer	Kermit, Texas	Summer, 1952	Salt Layer	200,000	47,000	Propane
Sacra Bros.	.....	Loco Hills, Eddy Co., N.M.	.....	.....	25,000	10,000	Propane
Sacra Bros.	.....	Loco Hills, Eddy Co., N.M.	.....	.....	.....	20,000	Propane
Sacra Bros.	.....	Loco Hills, Eddy Co., N.M.	.....	.....	.....	.....	Propane
Shamrock Oil and Gas Corp.	Producer	Panhandle Field, Texas	.....	.....	.....	.....	Propane or Butane
Shell Oil Co.	Prod.-Dist.	Elk City, Oklahoma	Summer, 1952	Salt Layer	35,000	.....	Propane
Shell Oil Co.	Prod.-Dist.	Wasson Field, Texas	Spring, 1953	Salt Layer	50,000	.....	Propane or Butane
Shell Oil Co.	Prod.-Dist.	Wasson Field, Texas	Spring, 1953	Salt Layer	50,000	.....	Propane or Butane
Shell Oil Co. (two wells)	Prod.-Dist.	Saranto-Near Baton Rouge, La.	.....	.....	.....	.....	.....
Skelly Oil Co.	Prod.-Dist.	Alto, Michigan	Fall, 1952	Salt Layer	100,000	.....	Propane
Skelly Oil Co.	Prod.-Dist.	Eldorado, Kansas	Fall, 1952	Salt Layer	100,000	.....	Propane
Skelly Oil Co.	Prod.-Dist.	Eunice, New Mexico	Spring, 1952	Salt Layer	50,000	50,000	Propane
Skelly Oil Co.	Prod.-Dist.	Eunice, New Mexico	Winter, 1952	Salt Layer	50,000	.....	Propane or Butane
Skelly Oil Co.	Prod.-Dist.	Skellytown, Texas	May, 1952	Salt Layer	60,000	60,000	Propane
Skelly Oil Co.	Prod.-Dist.	Skellytown, Texas	Summer, 1952	Salt Layer	60,000	57,000	Butane
Skelly Oil Co.	Prod.-Dist.	Skellytown, Texas	Winter, 1952	Salt Layer	60,000	.....	Propane
Southern Minerals Corp.	.....	Stratton Field, Texas	.....	.....	.....	.....	.....
Standard of Louisiana	Producer	Saranto-Near Baton Rouge, La.	.....	.....	.....	.....	.....
Standard Oil of Texas	Producer	Kelly-Snyder Field, Texas	.....	.....	.....	100,000	4-25,000 bbls.
Stanolind Oil & Gas Co.	Producer	Andrews, Texas (Three Bar)	Fall, 1952	Salt Layer	50,000	.....	Propane and Butane
Stanolind Oil & Gas Co.	Producer	Andrews, Texas (Three Bar)	Fall, 1952	Salt Layer	50,000	.....	Propane and Butane
Stanolind Oil & Gas Co.	Producer	Goldsmith, Texas (N. Cowden)	Summer, 1952	Salt Layer	50,000	40,000	Propane
Stanolind Oil & Gas Co.	Producer	Ulysses, Kansas	Summer, 1952	Salt Layer	25,000	25,000	Butane
Stanolind Oil & Gas Co.	Producer	Hastings Field, Texas	.....	.....	.....	.....	.....
Stanolind Oil & Gas Co.	Producer	Hockley Co., Texas (Slaughter)	.....	.....	100,000	.....	LPG
Stanolind Oil & Gas Co.	Producer	Hockley Co., Texas (Levelland)	.....	.....	50,000	.....	.....
Stanolind Oil & Gas Co.	Producer	Andrews Co., Texas (S.Fullerton)	.....	.....	100,000	.....	.....
Stanolind Oil & Gas Co.	Producer	Cochran	.....	.....	.....	.....	.....
Suburban Propane Gas Corp.	Distributor	Syracuse, N.Y.	Spring, 1952	Salt Layer	25,000	.....	Propane
Sun Oil Company	Producer	Beaumont, Texas	.....	Salt Dome	100,000	.....	Butane
Sun Oil Company	Producer	Sun Field, Texas	.....	.....	.....	.....	.....
Sunray Oil Company	Producer	Scurry, Texas	June, 1951	Salt Layer	75,000	42,000	Propane
Sunray Oil Company	Producer	Scurry, Texas	June, 1951	Salt Layer	100,000	60,000	Butane
Sunray Oil Company	Producer	Scurry, Texas	June, 1951	Salt Layer	100,000	40,000	Mix
Texas Company (The)	Producer	Sourlake, Texas	August, 1952	Salt Dome	100,000	100,000	Butane
Texas Company (The)	Producer	Sourlake, Texas	Winter, 1952	Salt Dome	100,000	.....	Butane
Texas Company (The)	Producer	Sourlake, Texas	Winter, 1952	Salt Dome	100,000	.....	Butane
Texas Company (The)	Producer	Scurry Co., Texas	.....	Salt Section	100,000	.....	Propane
Texas Gas Products Co.	.....	Chambers Co., Texas	.....	.....	.....	.....	.....
Texas Gas Products Co.	.....	Old Weiner, Texas	.....	.....	.....	.....	.....
Texas Gas Products Co.	.....	Old Pembrook, Upton, Texas	.....	.....	.....	.....	.....
Texas Natural Gasoline Co.	Producer	Upton, Texas	Fall, 1950	Salt Layer	100,000	100,000	Propane
Texas Natural Gasoline Co.	Producer	Upton, Texas	Fall, 1951	Salt Layer	100,000	75,000	Propane
Texas Natural Gasoline Co.	Producer	Upton, Texas	.....	.....	100,000	.....	Butane
Texas Natural Gasoline Co.	Producer	Barbers Hill Near Norsworth	.....	.....	.....	.....	.....
Texas Natural Gasoline Co.	Producer	Chambers Co., Texas	.....	.....	.....	.....	.....
Tex-Harvey Gasoline Co.	Producer	Midland, Texas	.....	Slat Layer	50,000	36,000	Propane
Tex-Harvey Gasoline Co.	Producer	Midland, Texas	.....	Salt Layer	50,000	36,000	Butane
Tex-Harvey Gasoline Co.	Producer	Midland, Texas	.....	Salt Layer	50,000	36,000	Propane
Tex-Harvey Gasoline Co.	Producer	Midland, Texas	.....	Salt Layer	36,000	.....	Mix
United Petroleum Gas Co.	Producer	Maiden Rock, Wisconsin	.....	.....	120,000	.....	Propane
Warren Petroleum Co.	Prod.-Dist.	Arcadia, Louisiana	Spring, 1952	Salt Dome	82,000	82,000	Mix
Warren Petroleum Co.	Prod.-Dist.	Arcadia, Louisiana	Summer, 1952	Salt Dome	82,000	82,000	Propane
Warren Petroleum Co.	Prod.-Dist.	Breckenridge, Texas	October, 1950	Mined Shale	20,000	20,000	Mix
Warren Petroleum Co.	Prod.-Dist.	Breckenridge, Texas	Summer, 1952	Mined Shale	30,000	30,000	Mix
Warren Petroleum Co.	Prod.-Dist.	Hattiesburg, Mississippi	Spring, 1952	Salt Dome	90,000	90,000	Mix
Warren Petroleum Co.	Prod.-Dist.	Hattiesburg, Mississippi	Summer, 1952	Salt Dome	90,000	90,000	Propane
Warren Petroleum Co.	Prod.-Dist.	Hattiesburg, Mississippi	Summer, 1952	Salt Dome	90,000	.....	Mix
Warren Petroleum Co.	Prod.-Dist.	Monument, New Mexico	August, 1952	Salt Layer	65,000	65,000	Propane
Warren Petroleum Co.	Prod.-Dist.	New Paris, Indiana	.....	Mined Shale	.....	.....	.....
Warren Petroleum Co.	Prod.-Dist.	Tyler, Texas	Summer, 1952	Salt Dome	85,000	.....	Propane
Warren Petroleum Co.	Prod.-Dist.	Tyler, Texas	Summer, 1952	Salt Dome	50,000	.....	Butane
Warren Petroleum Co.	Prod.-Dist.	Eola, Illinois	Spring, 1953	Mined Shale	50,000	.....	Propane

FIGURE 1
This tank, protected by magnesium anodes, is in perfect condition after three years' service.

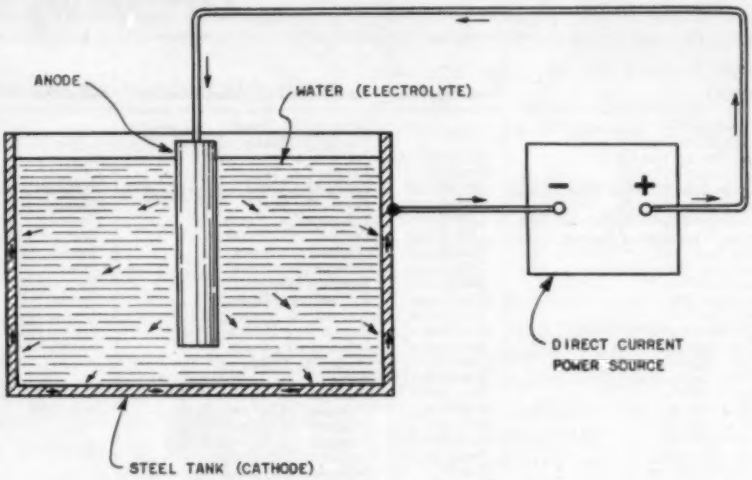


FIGURE 2
Here's an elementary diagram of cathodic protection installation applied to interior surface of tank.

How to Save Steel Tanks

Corrosion can be virtually eliminated . . . .

- **By insulating metal through application of protective coating to tank surface.**
- **By application of cathodic protection current to surface of submerged metal.**

By HARRY J. KEELING, Consulting Engineer

TANKS TAKE an unnecessary beating in the oil industry. The corrosion caused by brackish water, basic water and sediment virtually can be eliminated. Here is a review of the means of mitigating this unnecessary corrosion.

Since galvanic corrosion on a metal surface immersed in water is accompanied by an electric current flow from the metal into the water, pitting or rusting can be reduced or completely eliminated by suppressing this current flow. There are at least two general methods of accomplishing this:

- By insulating the metal surface from the water through the application of a protective coating to the surface of the tank. (Paints or coal tar coatings depend upon this principle for their success).
- By application of a cathodic protection current to the surface of the submerged metal to maintain it at a negative potential with respect to the water. The existing corrosion-causing voltages are thus neutralized, thereby preventing current flow from the metal into the water.

When a submerged steel surface is receiving cathodic protection, a protective film of hydrogen is formed at the surface of the metal, and this film is constantly renewed by keeping the metal surface charged cathodically with respect to the water. To maintain this charge, it is necessary to provide an external source of direct current electric power.

The magnitude of the current required is dependent upon the specific resistivity of the water, the amount of exposed area of metal and the resistance of the film of paint, oxide, grease, etc. on the surface of the metal.

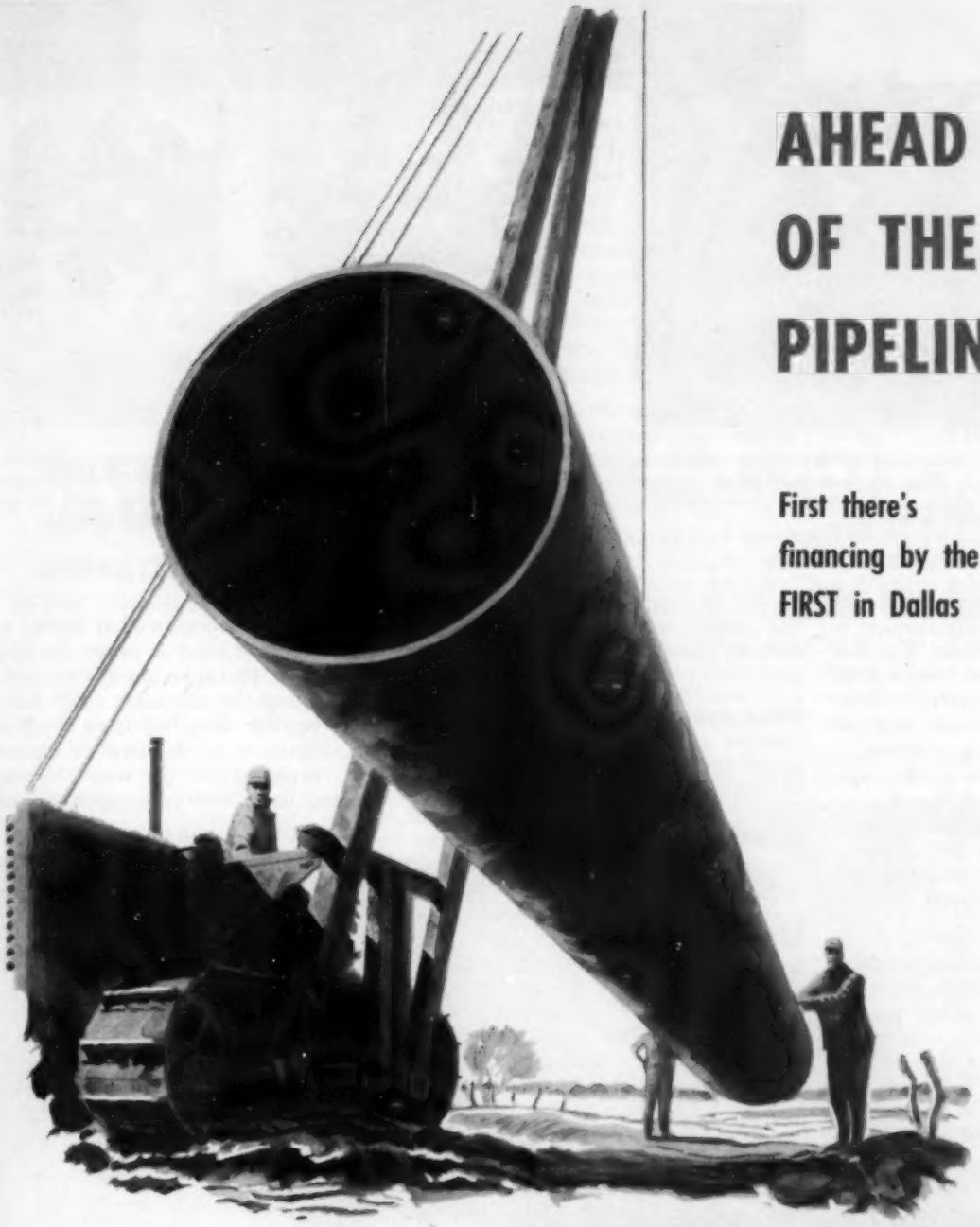
Figure 2 shows an elementary diagram of a cathodic protection installation applied to the interior surface of a tank. The metal tank is the cathode since it is connected to the negative pole of the direct current source. The current flows into the water by leaving the surface of the anode, which is suspended in the liquid and is connected to the positive terminal of the power source. The choice of material for the anode will be discussed later.

Power Sources

The current required for a cathodic protection installation can be supplied by any convenient source of direct current energy and this choice is usually dictated by economic considerations. Rectifiers have been frequently used where commercial power is available. Galvanic or sacrificial anodes are probably the best source of electrical energy where commercial power is not available. Each of these basic sources of electrical energy has its advantages under certain conditions.

RECTIFIERS. Many cathodic protection installations employ the dry disc or plate type rectifier which converts the usual alternating current commercial power to a direct current. These rectifier plates may consist of copper in contact with copper oxide, copper sulfide in contact with magnesium, or selenium in contact with iron. The complete rectifier unit usually comprises a transformer to reduce the voltage from 230 or 115 volts to 20 volts or less, with tap-changing links or rheostats to adjust the voltage, and with fuses or circuit breakers to protect the equipment from overload.

There are numerous modifications to this basic design, to suit local conditions. For instance, in some cases, forced draft ventilation of the rectifier stacks is used in order to reduce the overall physical size of the unit. Oil-immersion of either the rectifier stacks or the complete unit may be



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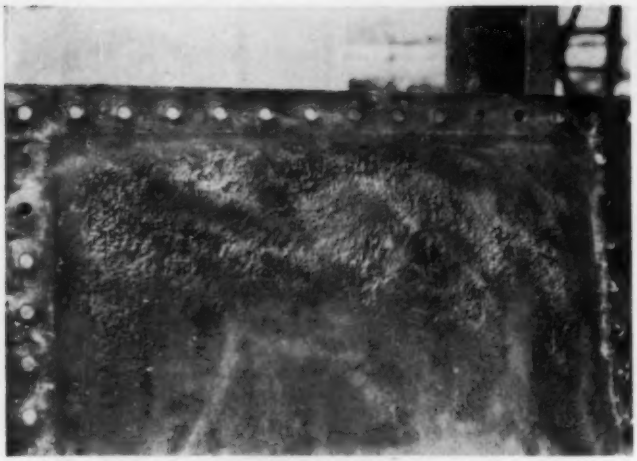

Figure 3. Close-up of plate removed from three-ring wask tank, similar to that in Figure 1. This gives indication of amount of corrosion which takes place in two years where cathodic protection is not used.

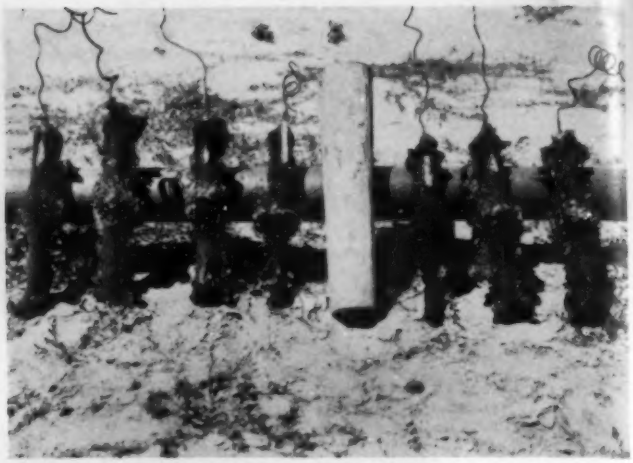

Figure 4. Anodes removed from wash tank shown in Figure 1. They had been in service 122 days. Compare new 16-pound anode in center of group. These anodes were used to give cathodic protection to tank walls and steam coils.

used to prevent atmospheric corrosion of the parts where the installation is subject to severe fog or mist. The use of hot-cathode tube type rectifiers in place of the plate type rectifiers may in some cases result in lower original cost where high voltage is required.

Although motor generators have been used as a source of direct current for cathodic protection stations, this source of power is less popular because of the higher maintenance cost due to the moving parts.

GALVANIC ANODES. Referring again to Figure 2, if the material selected for the anode is magnesium or zinc, the external source of direct power can be eliminated in cases where the total circuit resistance is not too high. The magnesium anode rod and the steel tank constitute a galvanic cell in which the magnesium is the anode, the interior steel surface of the tank is the cathode, and the water is the electrolyte. Since magnesium has a higher solution potential than the iron, a driving force of approximately one volt is obtained from this combination, and the necessary cathodic protection current flows through the circuit. In installations of this type, the magnesium anodes are gradually dissolved at a rate proportional to the current flowing. It requires approximately 18 pounds of magnesium to deliver a current of one ampere for one year. The number of magnesium or zinc anode rods required to protect a tank depends again upon the composition of the water, the coating on the surface of the tank, agitation of the water, etc. Because of the low voltage available, however, it will usually require considerably more galvanic anodes to protect a tank than if an external source of direct current is used. Increasing the number of anodes in a tank lowers the total circuit resistance and provides increased current density at the surface of the steel.

Since the anode attached to the positive pole of the direct current power source shown in Figure 2 is discharging current into the water, it will be subject to anodic corrosion and therefore gradually dissolve away. The rate at which the anode is corroded will depend upon the type of material used, the current flowing and the composition of the dissolved materials in the water. Since it would be very desirable to eliminate the anode replacement costs, considerable effort has been spent in developing "permanent" anodes which will either be dissolved at extremely slow rates or preferably not dissolved at all by the action of the cathodic protection current. The list of materials that have been used for anodes in tank installations is quite lengthy. Only the most common materials in use today will be discussed briefly.

PLATINUM. Platinum wires have been used successfully as "permanent" anodes for tank protection and have the advantages of light weight and long life. Generally speaking, platinum anodes are inert and are not subject to corrosion. There have been a few exceptional cases reported where platinum anodes were dissolved through the action of the current flowing from them, but these were unusual and abnormal cases. The chief disadvantage of using platinum is its high cost. To minimize the weight of material required, platinum anodes are usually constructed in the form of thin wires which are suspended vertically in the tank. The small physical size of the platinum anodes results in higher circuit resistance, making it necessary to use somewhat higher applied voltage than if other materials were used. Platinum anodes are rather fragile and the wires are easily lost if they become detached from the holders. Platinum anodes tend to increase the corrosivity of the water through raising the dissolved oxygen content.

CARBON. Carbon or graphite anodes have been used in some applications because here again is a material that is not readily attacked by anodic corrosion. Unfortunately, carbon anodes cannot be considered as "permanent" because experience has shown that in many waters they disintegrate rapidly through the combined action of the current flowing and the gases or salts dissolved in the water. Other disadvantages to the use of carbon or graphite anodes are high original cost, weight and difficulty in obtaining sufficient mechanical strength. Carbon or graphite anodes also introduce a back electromotive force into the circuit which makes it necessary to increase the rectifier voltage by approximately one volt.

IRON. The iron anodes have the advantage that they are usually readily available from the scrap heap, are mechanically strong and easily replaced. First cost is low, particularly if scrap steel pipe is available. The disadvantages, however, usually outweigh the above advantages and make it desirable to select other materials for tank anodes. Iron anodes are dissolved at the rate of approximately 20 pounds per year for every ampere that is discharged. At $80 per ton for iron scrap, this amounts to about $1.15 per ampere per year for material, allowing for 70 percent utilization efficiency. As the iron anodes are rusted away, the corrosion products

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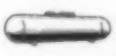

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fall into the water and may cause discoloration. Since anodes made of iron or any of the other metals that are dissolved have to be replaced more frequently than the platinum anodes, the replacement cost is an important item. If attempt is made to increase the period between replacements by providing additional anode material, the weight of the anodes introduces severe structural problems. Most tank roofs are designed to withstand the normal load from wind, snow, etc., with very little provision for additional dead load. Since the anodes are usually suspended from the roof of the tank, consideration must be given to the total weight of the anodes because of the additional load imposed on the roof. In the older tanks, the cost of reinforcing the roof may make it impractical to use iron anodes heavy enough to provide a reasonable life.

ALUMINUM. Aluminum anodes have been popular during recent years because they offer the advantage of light weight and the corrosion products adhere to the anode. The material is easy to handle or replace, and is not as fragile as either the platinum or the graphite anodes. An inherent advantage of aluminum over other materials for anodes is its low electrochemical equivalent. Aluminum anodes are dissolved at the rate of approximately eight pounds per year per ampere of current flowing. Outweighing these advantages is the fairly high initial cost of aluminum metal, which amounts to approximately $3.80 per year per ampere of current.

MAGNESIUM. As previously indicated, magnesium can be used as a galvanic anode without applying voltage to the circuit from external power source. In recent years, however, magnesium has frequently been used in tank installations with current supplied from an external source. Although the first cost of magnesium is greater than for aluminum, this is balanced by certain advantages inherent to magnesium that are not shared by aluminum. Magnesium is light in weight and therefore introduces very little structural load to the roof of the tank; it is mechanically strong and easily replaced; it contributes approximately one volt emf. to the circuit, and the corrosion products adhere to the anode. Magnesium anodes are dissipated in water at the rate of about 18 pounds per year per ampere of current. This amounts to between $10 and $13 per year per ampere of current.

Magnesium has an additional advantage over other types of anodes, which tends to offset its high original cost. After a cathodic protection system has been in operation for some time on a steel tank, it will be noticed that the bare portions of the steel become covered with a white coating of salts precipitated from the water. This white deposit contributes to the protection received by the steel surface by materially increasing the circuit resistance and reducing the current density required for protection. The type of scale produced will depend on the chemical salts present in the water. In general, where the waters contain large quantities of magnesium in solution, a hard, dense, permanent scale will be produced. The use of magnesium anodes results in the formation of durable protective scales of this type even in waters low in magnesium content. By comparison, the scale formed in tanks using aluminum anodes is fragile and more easily brushed from the surface of the steel through mechanical agitation of the fluid.

About the Author

HARRY J. KEELING was born in England and after receiving primary education in Canada, moved to Los Angeles, California where he attended high school. He received a B.S. in mechanical engineering from California Institute of Technology in 1929 and an M.S. in mechanical engineering in 1930. In 1930 he joined Southern Counties Gas Company, Los Angeles, and has been designer and assistant distribution engineer. He is now a mechanical engineer with the company. In addition to mechanical and structural design, his activities have included cathodic protection design, telemetering and remote control and, in recent years, design and operation of a mobile radio communication system.

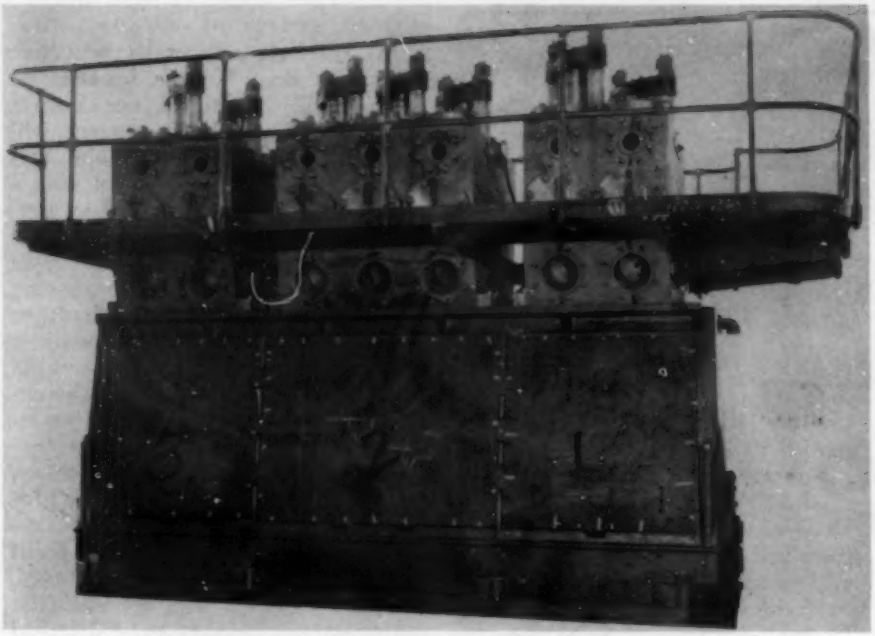
Advantages of Cathodic Protection

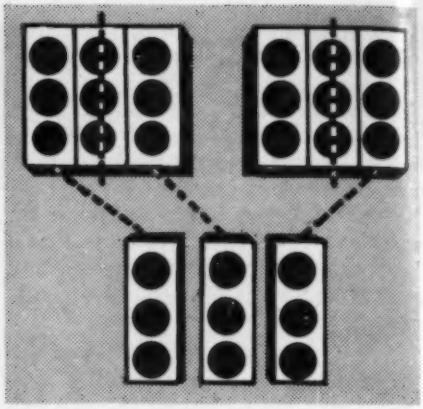
The inherent advantage of cathodic protection over the use of paints or protective coatings alone for tank interiors, lies in the fact that the cathodic protection system provides a "self-healing" protective film over the exposed surface of the submerged metal. If for any reason the protective coating is disturbed or broken, no damage will take place, because in a short time the cathodic current will build up a new protective film and eventually cover the bare spot with a scale of salts deposited from the water. The use of cathodic protection, therefore, is particularly advantageous in reducing corrosion rates on moving mechanisms. It is very difficult to maintain such protective coatings where one metallic surface scrapes across another. In such cases, the cathodic protection will prevent corrosion on the bare spots where protective coating is broken or worn away.

Another advantage of cathodic protection is the fact that it can be applied to a structure where the paint or protective coating has failed. Whereas in most cases the cathodic protection equipment can be installed without taking the tank out of service, reconditioning of coating or repainting the tank can only be done after it has been drained. This is an important factor where corrosion is taking place in steel tanks, and it is not possible to remove them from service long enough to replace the coating.

Decision as to whether to use cathodic protection alone or in conjunction with the protective coating rests on the enonomic considerations involved. Each individual case should be judged on its own merits. Where labor costs for coating applications are excessive, consideration should be given to the use of a medium-priced protective coating supplemented by the use of cathodic protection as "insurance" to take care of holidays that may develop, or to provide protection after the coating has ultimately failed. When applying cathodic protection to a completely bare tank, the usual procedure is to apply heavy polarizing current for the first few days or weeks, until a deposit of scale is built up on the surface of the metal. Maintenance of protection after the scale has once been built up requires much less current, which can be supplied by a smaller power source or even galvanic anodes.

In certain engineering applications involving corrosive water where the tank is required to be in service for a limited period of time, perhaps only one or two years, it may be advantageous to use cathodic protection on the bare tank since the high operating cost is offset by the high salvage value of the cathodic protection equipment. On the other hand, if the tank is to be protected from corrosion by means of a coating alone, it is difficult to recover the cost of this coating when the tank is retired or moved.





REPAIRS WERE MADE by cutting up two cracked cylinder blocks, machining three sections, and bolting them together to form a single cylinder block. By repairing the cylinder, the company saved $7000 and five months time in getting the pump back into operation.

Service Craftsmen Salvage a Cylinder

Company saved $7000 and five months pumping time. Reciprocating pump put back into operation by making one working cylinder from two broken ones.

By CARL I. HUSS, Service Pipe Line Company, Tulsa

SERVICE PIPE LINE CRAFTSMEN recently saved the company $7000 and five months pumping time in getting a reciprocating pump at Freeman station, Missouri, back into operation. They did it by making one good cylinder from two broken ones.

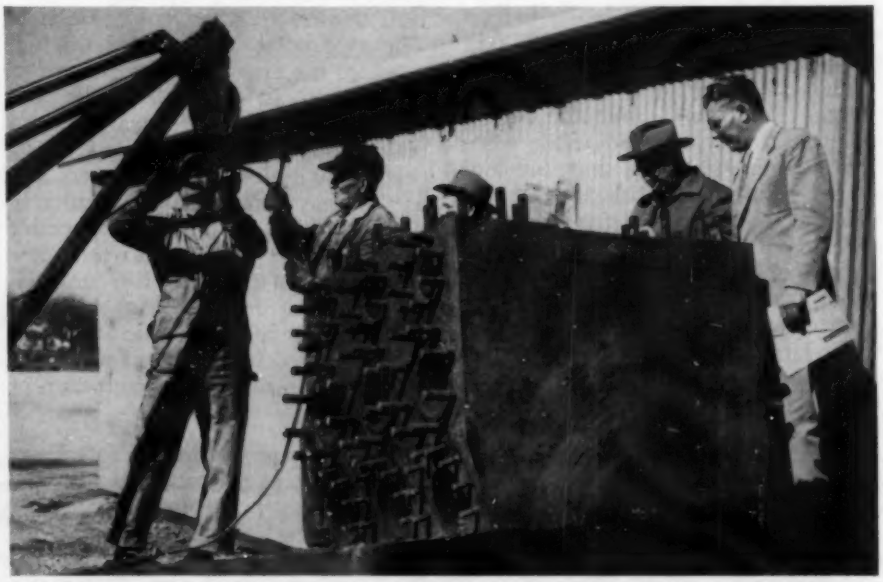
Had they sent to the factory for a replacement it would not have been delivered until late summer. Since Freeman station is the spot where Service Pipe Line's pumpings from Wyoming, Kansas, Oklahoma, Texas and New Mexico converge for relay to the refining areas of Kansas City, St. Louis and Chicago, it was vital that the unit get back into operation as soon as possible.

The job involved considerable mechanical and machinist know-how, and a bit of luck.

The bit of luck came about because the employes were able to buy back from a Carrollton, Mo., junk dealer a broken cylinder they had sold him several months previously. Luckily the ten-ton cylinder was so large that the junk dealer could not cut it up profitably. Consequently he was happy to resell it to the company. It originally had come from a septuplex pump which company machinists had found broken in the middle of the center forging of three cylinders.

Temporary repairs were made and it was replaced. Some months later the Carrollton station was electrified and the cracked cylinder wound up in the hands of the local junk dealer.

But it wasn't forgotton. Early in



A CRACKED BLOCK arrives at Service's Tulsa Machine Shop. It weighed 10 tons.

1954, mechanics at the Freeman station discovered a similar crack on an identical cylinder.

The men, Orville Watson, division master mechanic; Bill Atwater, division machinst; Charles Plattner, assistant division machinist, and Stanley Kuntz, division machinist from Carrollton, went into a huddle. From their discussion came this idea: Send the two cracked cylinders to the Tulsa machine shops, have the two cylinders cut apart and machined into one good fabrication.

Watson discussed the matter with the persons concerned at Tulsa and all agreed it was worth a try. The whole idea hinged on whether the Carrollton junk dealer still had the cracked cylinder. He did.

The cylinders, weighing ten tons each, arrived at Tulsa by truck February 16 and 17.

By that time blueprints had been drawn and the craftsmen readied for the job. First they cut the two cylinders down the middle along the cracks. Then because Service's machine shops do not have a large planer they farmed out the split cylinders to the Marshall Machinery Company at Tulsa for planing. Marshall owns a large Putman planer.

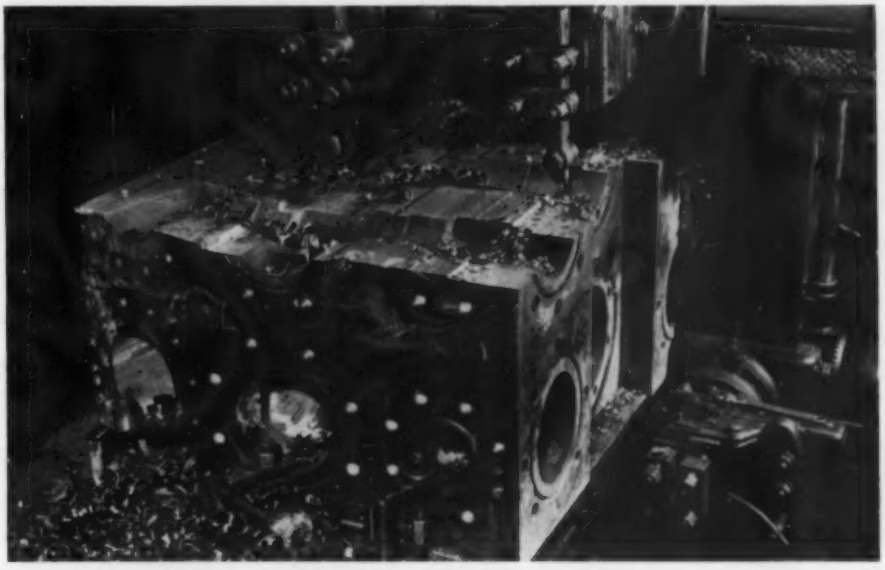
During the planing operations at Marshall's, Service Pipe Line machinists made six 53-inch-long bolts, four of them 1½ inches in diameter and two of them two inches in diameter. Made of SAE 4140 steel, they would bind the finished fabrication together.

As Marshall's machinists finished planing the pieces they sent them back to Service's shops where Machinist Rex Bowman drilled the six bolt holes. He used a radial drill.

The men had the finished job on its way to Freeman March 25. It arrived before the mechanics had finished their overhaul on the engine and pump, so there was no delay while they waited for the repaired part. They put the pump back into service April 7.

Thanks to the Missouri mechanics' brilliant idea and the Tulsa machine shop's personnel for executing the idea they were able to save the company a substantial sum of money and—equally important—time.—**The End**

BLOCK WAS CUT down the middle about where the crack occurred by Shop Welder Willie Prather. Only the two outside sections were salvaged.



PLANING MACHINE had difficulty cutting torch-hardened steel. Four slabs went through this process giving three for fabrication and one spare.

FINAL RESULT is a new cylinder block made up of three slabs bolted together. Grouped around it are the men who did the job. Left to right are P. A. Howard, Walter Phillips, Robert Hurry, Pete Peterson, Willie Prather, Howard Wilson, Grover Zumwalt, George Burgess and Rex Bowman.

Rules of Thumb

FOR THE PIPELINER'S NOTEBOOK

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Miscellaneous

—16—How to size pipe lines for water flow.

This form gives a reasonable degree of accuracy.

$$d^5 = \frac{(GPM)^2\,(D)}{(10)\,(H)}\,(100)$$

d = inside diameter of pipe in inches
GPM = gallons per minute
D = equivalent distance (in feet) from standpipe (or pump) to outlet
H = total head lost due to friction in feet

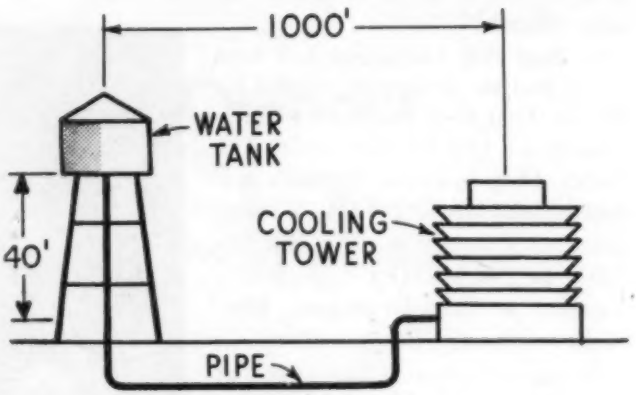
Example: What size line should be run from a water tower to a cooling tower for a minimum of 160 gpm if the equivalent distance (actual distance in feet plus allowances for valves and fittings) is 1000 feet and the minimum head supplied by the tower will always be at least 40 feet?

Solution:

$$d^5 = \frac{(160)^2\,(1000)}{(10)\,(40)\,(100)} = 640 \text{ inches}$$

Rather than extract the fifth root of 640, simply raise inside diameters of logical pipe sizes to the fifth power and compare them with 640.

If three-inch ID pipe were used



$d^5 = (3)\,(3)\,(3)\,(3)\,(3) = 243$

This is obviously too small.

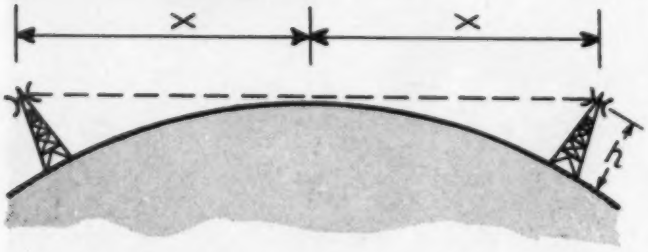
Trying four-inch pipe

$d^5 = (4)\,(4)\,(4)\,(4)\,(4) = 1024$

This pipe is obviously larger than necessary, but it is better to use pipe too large than too small. For a more technical discussion of this problem, see page 66, August 1954 PIPE LINE INDUSTRY.

Engineering Design

—17—How to calculate microwave hops on level ground.



RULE: Excluding obstructions such as hills etc., the microwave (line-of-sight) distances between two towers will be twice the distance from the transmitter to the horizon. The line-of-sight distance in miles from the top of the tower to the horizon can be found by adding the square root of the tower height to the square root of the first square root (the latter of course is the fourth root).

$$x = \sqrt{h} + \sqrt{\sqrt{h}} \text{ or } \sqrt{h} + \sqrt[4]{h}$$

Example: How far apart can 100-foot-high towers be spaced to provide line-of-sight transmission if there are no obstructions between them.?

$$X = \sqrt{100} + \sqrt{10}$$
$$X = 10 + 3 + \text{ or } 13 \text{ miles}$$

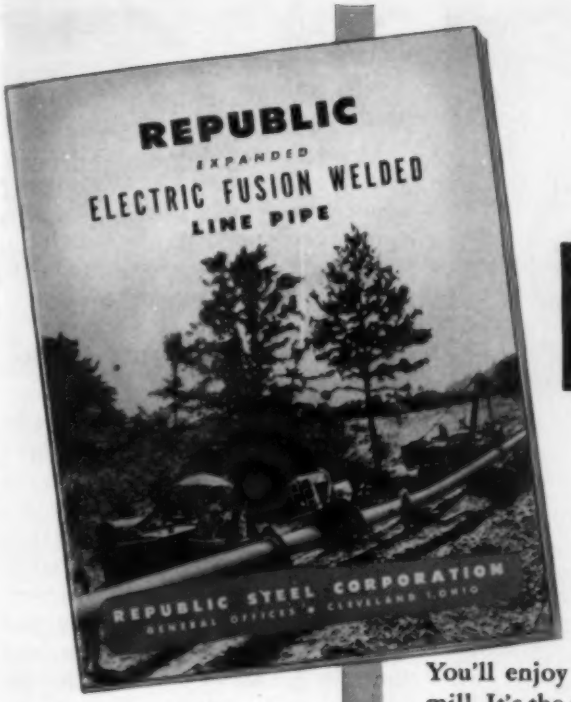
Distance between towers can be 2X or 26 miles.

This same formula can be used to estimate distances in an airplane.

Example: How far is the line of sight distance to the horizon in an airplane flying at an altitude of 4900 feet.

$$(\sqrt{4900} = 70)$$
$$X = \sqrt{4900} + \sqrt{70}$$
$$X = 70 + 8+$$

Distance to horizon is 78 miles.



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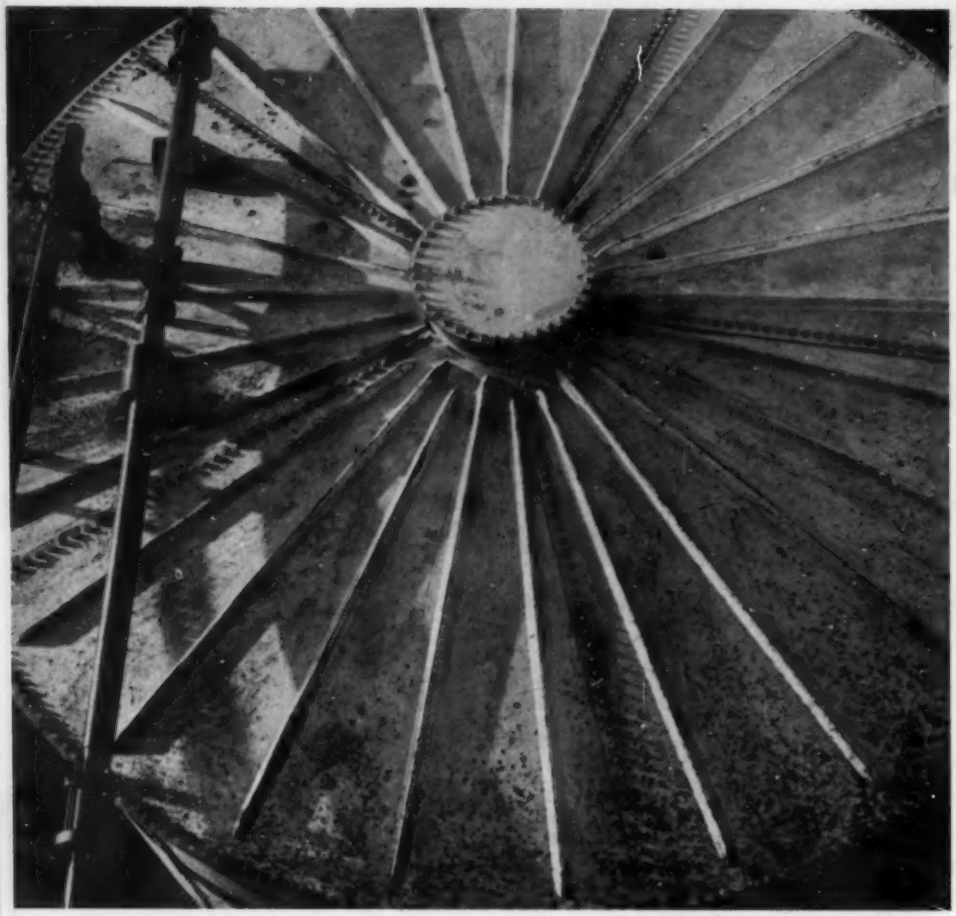
City_____ Zone_____ State_____



PLASTIC DECK AND DOME on a 250-bbls. plastic storage tank on a lease in Kansas. Stainless steel bolts and neoprene gasket assure a tight and non-corrosive deck.

Corrosion-Resistant Plastic Tanks Have Great Strength

Synthetic resin reinforced by glass has tensile strength of 72,000 psi. Tanks made from it resist the corrosive action of H_2S as well as most acids.

By ANTHONY GIBBON, PIPE LINE INDUSTRY's Staff

SEVERAL CRUDE OIL storage tanks made of plastic are withstanding the corrosive action of extremely sour crude oil produced by wells in Oklahoma, Kansas, Texas, and Canada. The tanks have been in service for eight months to a year in areas where conventional tanks have had to be repaired or replaced anywhere from 3 to 18 months.

Hydrogen sulfide is the number one corrosive enemy of tanks. To combat it, one manufacturer began investigating various plastics several years ago. The problem was to find the right combination which would meet four basic requirements.

- It had to possess superior corrosion resistance.
- Its structural and retention strength had to be more than adequate.
- Its fabrication should not present unusual difficulties.
- Its ultimate cost should be reasonable.

Although engineers suspected that probably the cost of manufacture would considerably exceed that of a conventional tank, it was felt that a plastic tank could overcome this factor by eventually proving more economical because of its resistance to corrosion and consequently its longer period of service.

One of the first combinations to be tried was a polyester resin, reinforced with chopped strand mat. To test the strength of these materials, many prepared samples for tensile testing were tested thoroughly on a tensile testing machine. The specimens were 18 inches long, 3 inches wide and ⅛ inch thick. Both the thickness and the layup methods were identically the same as those intended for use in fabricating tank staves, bottoms, and decks.

Table 1 shows typical test results obtained from various reinforced plastics. Based on these, the epoxy resin and the uni-directional glass mat was selected because it was found this combination retains a strength comparable to that of steel. A specimen, ⅛ inch thick and necked down to a 1 inch width, withstood a direct pull of close to 10,000 pounds. In effect this means uniform tensile strengths in the vicinity of 72,000 pounds per square inch.

Special construction assures watertightness. Experimentation showed that a neoprene gasket provided the most reliable seal for temperatures which might range from —40° F. up to 200° F. To keep the gasket in the seams and to force it tightly against the bolts, special self-sealing joints were devised, upon which patents are pending. Raised ridges, about half the thickness of the gasketing material, are molded along one end of each

TABLE 1
Strength Ratings of Representative Samples From Over 300 Pull Tests

Type Resin	Type Mat	Tensile Strengths PSI	REMARKS
Polyester	Chopped Strand	13,360 to 19,880	Strength too low and inconsistent. Increasing glass increases strength and porosity. Porosity caused wicking or "weeping," especially so with oil at temperatures above 100 F. This combination was not satisfactory.
Polyester	* Multi-Unidirectional	30,000 to 50,000	Strength satisfactory. Porosity discovered as being caused by resin shrinkage. This resin "pullaway" from the fiber permits weeping. Resin shrinkage could not be overcome consistently. After building many tank parts and some tanks, this combination was finally discarded.
Epoxy	* Multi-Unidirectional	65,600 to 72,000	Stronger than Bolted Tank Steel. Shrinkage less than 1/10 that of polyester resins, thus no weeping. This combination very satisfactory.

* Unidirectional strands in both directions to give good tensile strength in all directions.

tank stave, running the full length of the stave. In addition, a similar ridge is molded to encircle each bolt hole. This type of self-sealing joint is incorporated in all seams of the tank.

It was found through experimentation that ridges on both ends of successive staves would either cut the gasket, or rest on top of each other, making a tight seal very difficult. Sealing ridges are, therefore, molded along one edge of each stave only, the mating end of the next stave or piece being perfectly flat.

Hydrostatic tests on tanks 15 feet, 6 inches in diameter and 32 feet, 2 inches high indicate a safety factor of 2-to-1 for tanks of the same diameter and 16 feet high. Safety factors on other stock sizes are as follows:

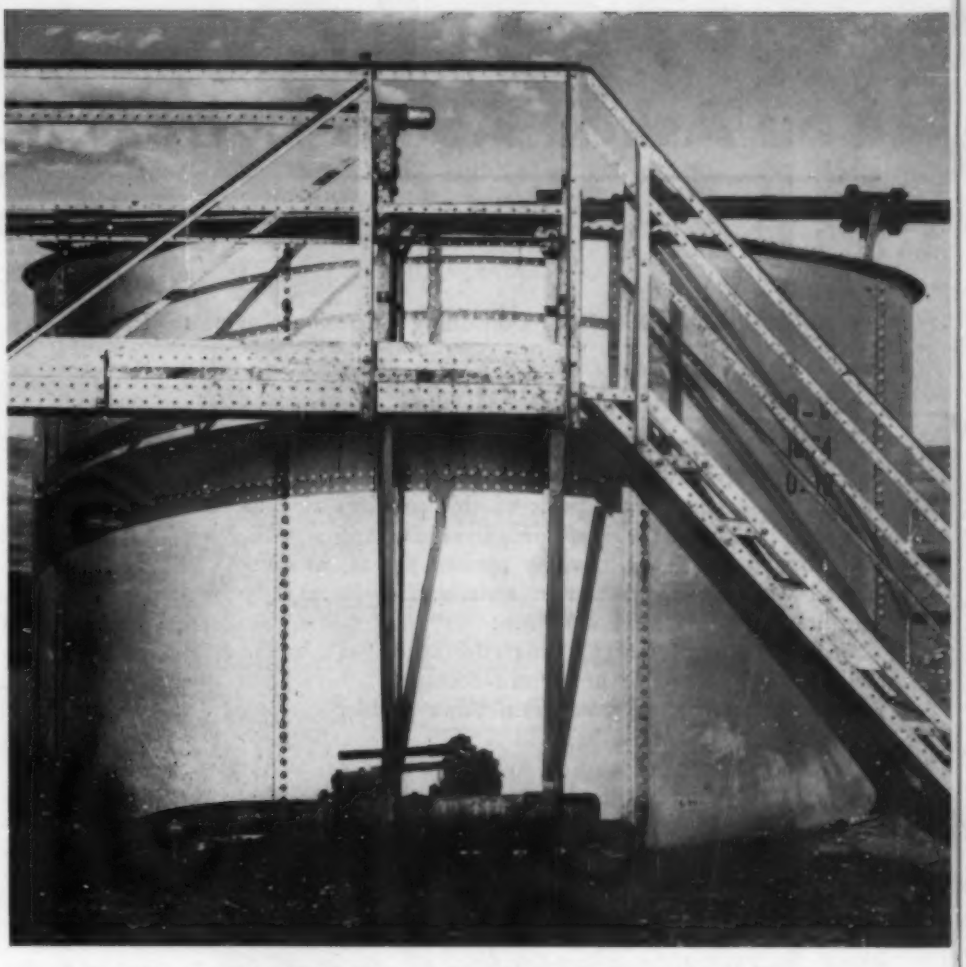
Size	Safety Factor	Source
100 bbl	5.8 to 1	Calculated
200 bbl	2.9 to 1	Calculated
250 bbl	3.5 to 1	Proof tested
Hi 500 bbl	2 to 1	Proof tested
Lo 500 bbl	2.5 to 1	Calculated

Tank staves, decks, bottoms and accessories are manufactured in a series of steam-heated hydraulically operated molding presses. All molding surfaces are machined to tolerances of a few thousandths of an inch, polished, chrome plated and repolished, for maximum smoothness and easy removal of the part after curing. Maximum strength and toughness of the tank parts is achieved by high-pressure curing at about 250° F. Finished tank parts are after baked for one hour at 375° F.

The primary advantage of plastic tanks is their resistance to corrosion. Table 2 shows the effects of various corrosive liquids and indicates that over an extended period of time sour crude oils do not harm the tanks. Acid mixtures have no corrosive effect. Accelerated life tests conducted at elevated temperatures indicate these tanks should have a service life of many years in critical areas in the field, in pipe line tank farms and in refineries and petrochemical installations.

TABLE 2
Chemical Resistance of Resin Tank

Effect of sour or sweet oil	None
Effect of salt water at 150 F. 1000 hours	None
Effect of acid mix (10 percent by volume sulfuric, nitric, hydrochloric)	None
Effect of weak acids	None
Effect of weak alkalies	None
Effect of strong alkalies	None
Effect of very strong alkalies	Slight



PLASTIC STORAGE TANK on a sour crude oil lease near Odessa, Texas.

Weight is another advantage. Fully assembled, a 250-barrel epoxy-glass tank weighs 1600 pounds as compared to three times the weight of a conventional tank.

An important advantage of the plastic tank is its amortized cost. From a first cost consideration alone, the plastic tank cannot compete, being about twice as expensive as a conventional tank of the same capacity. However, in sour crude lease tankage or other applications where corrosion ordinarily knocks out new equipment every few months, plastic tanks should justify the first cost. Because of their resistance to corrosion plastic tanks eliminate lease shutdown time, freight, material and labor costs incidental to repeated tank repairs and frequent replacements.

—The End

ACKNOWLEDGMENT
The writer thanks John F. Gibb, manager, Plastics Division, National Tank Company, and field men who furnished the information contained in this article.

TABLE 3
Effect of Various Chemicals on Epoxy Resin Samples

SOLUTION	Concentration	Flexural Strength 73,350 psi Samples Post Cured 1 Hr. at 400 F. Absorption 7 Days Percent	Absorption 30 Days Percent	Absorption 84 Days Percent	Modulus of Elasticity 3.33 x 10^6 psi Flexural Strength After 84 Days in Solution psi	Modulus of Elasticity After 84 Days in Solution psi	Resin Content 35.5 Percent (by weight) Remarks
H_2SO_4	70 Percent	0.108	0.196	0.260	73,150	3.03 x 10^6	
H_2SO_4	3 Percent	0.0179	—0.090	—0.449	63,550	2.84 x 10^6	
NaCl	20 Percent	0.126	0.240	0.382	67,950	3.20 x 10^6	
HCl	37 Percent	0.0112	—0.210	—0.893	54,700	2.57 x 10^6	
HNO_3	50 Percent	Top layer eaten away					
HNO_3	30 Percent	0.0484	—0.206	—1.73	41,950	1.92 x 10^6	Samples turned red
NaOH	50 Percent	0.0055	—0.234	—0.752	71,900	2.25 x 10^6	
Ethylene Dichloride		0.130	0.349	0.569	69,350	2.81 x 10^6	
Phenol		0.082	Sample Chipped				
Jet Fuel		0.0210	0.084	0.145	71,850	3.25 x 10^6	
Gasoline		0.0118	0.074	0.134	69,900	3.04 x 10^6	
Ethylene Glycol		—0.0353	—0.027	—0.0312	77,750	3.28 x 10^6	

You Asked About Corrosion . . .

MARSHALL E. PARKER

By **MARSHALL E. PARKER,** Consulting Corrosion Engineer

Q.—What are the advantages of zinc as a material for galvanic anodes? What are its limitations? D. L. M.

A. We must consider as parts of this problem zinc as contrasted with magnesium for galvanic anode service, and also, the idea of galvanic anodes *per se,* as contrasted with impressed current systems. In general, the advantages of galvanic anodes are:

1. Flexibility of design, when the structure under study is highly variable in current demand;

2. Relative freedom from interference problems, especially in intricate networks; and

3. Independence of outside sources of power.

The usually named disadvantages of galvanic anodes are:

1. Low power output, and usually lower efficiency, in high resistivity soils—they are, in fact, virtually useless in extremely high resistivity areas;

2. Higher costs per ampere-year, and especially higher initial costs; this is sometimes offset by superior distribution; and

3. The multiplicity of installations makes routine inspection and testing of the system more time-consuming and more expensive.

With a single possible exception, all of the listed characteristics are possessed both by zinc and magnesium; we must look elsewhere for their differences. Zinc is less expensive per pound; on the other hand, it has a lower ampere-hour equivalent per pound, which just about offsets the cost differential. However, at low current output, the electrochemical efficiency of zinc does not decline as much as that of magnesium (it is, in fact, higher at virtually all levels), so that under these conditions the total metal cost for a given quantity of electrical output may be less for zinc. These levels are only reached under conditions which project lives of twenty years or more under most conditions.

Another advantage, often claimed for galvanic anodes in general, is actually valid only for zinc. It is said that since a minor part of the total circuit resistance lies in the anode contact itself, galvanic anodes tend to be self-regulating. That is, if there is damage to or deterioration of the coating on a line, so that the line contact resistance decreases, there will be a significant increase in anode current output. This will only be true if the pipe-to-soil potential is carried at a value very nearly equal to the open-circuit anode potential—in other words, about 1.6 volts for magnesium and 1.1 for zinc. Very few magnesium installations are carried to such potentials; ordinarily a criterion of 0.85 volts is employed, which means that much of the line is at about 0.9 to 1.0 volts, and only near the anodes do the values approach the magnesium potential.

In order to bring a line to anode potential, it is necessary to install more anodes than are required for minimum protective values. These additional anodes, as the line approaches the anode potential, do not materially increase the total current output of the entire number of anodes on the line—the output per anode drops as more are added. This additional capacity is ready, then, on a stand-by basis, and will be produced whenever anything tends to lower the potential of the line. If a given line is at an initial (unprotected) average potential of 0.6 volts, an extensive zinc installation would bring it to about 1.0, an extensive magnesium installation to about 1.5; thus it is seen that a shift of 0.4 volts is required in the first case, and 0.9 in the latter. In both cases the anodes would be operating at low current values; the efficiency of the magnesium would fall to perhaps 30 percent, while that of the zinc would be near 90 percent. Such a system would be prohibitively expensive with magnesium.

A system of this type—essentially a constant-potential cathodic protection system—should appear most attractive to the owners of lines with very superior coatings. These would have small current demands, and the self-regulating character of the installation would offer protection against coating damage and failures, up to a point. Current output surveys would indicate changes in coating resistance (potential surveys would not show much change until the failure had proceeded too far) in time for remedial steps to be taken. The very low current density in the soil would make interference with other structures almost impossible.

There is still another advantage of zinc, when lines with very superior coatings are being considered. Such lines are well insulated from the earth, and actually *need grounding* from a safety standpoint. Magnesium anodes, installed in low resistivity soil, and connected to the line by means of heavy conductors without resistors, may well supply two to four times the amount of current needed for protection; zinc anodes so connected cannot supply more than enough current to bring the potential to about 1.1 volts, as described above. Hence, when used liberally for grounding purposes, zinc will not be wasteful in consuming itself by galvanic action, but will supply only about the amount needed; and in so doing, will maintain a relatively high current efficiency.—*The End.*

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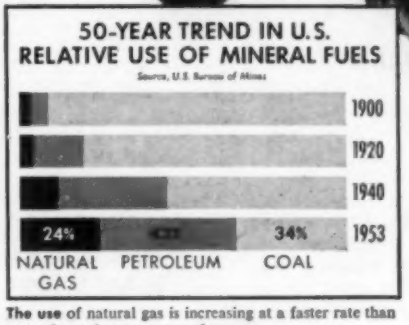

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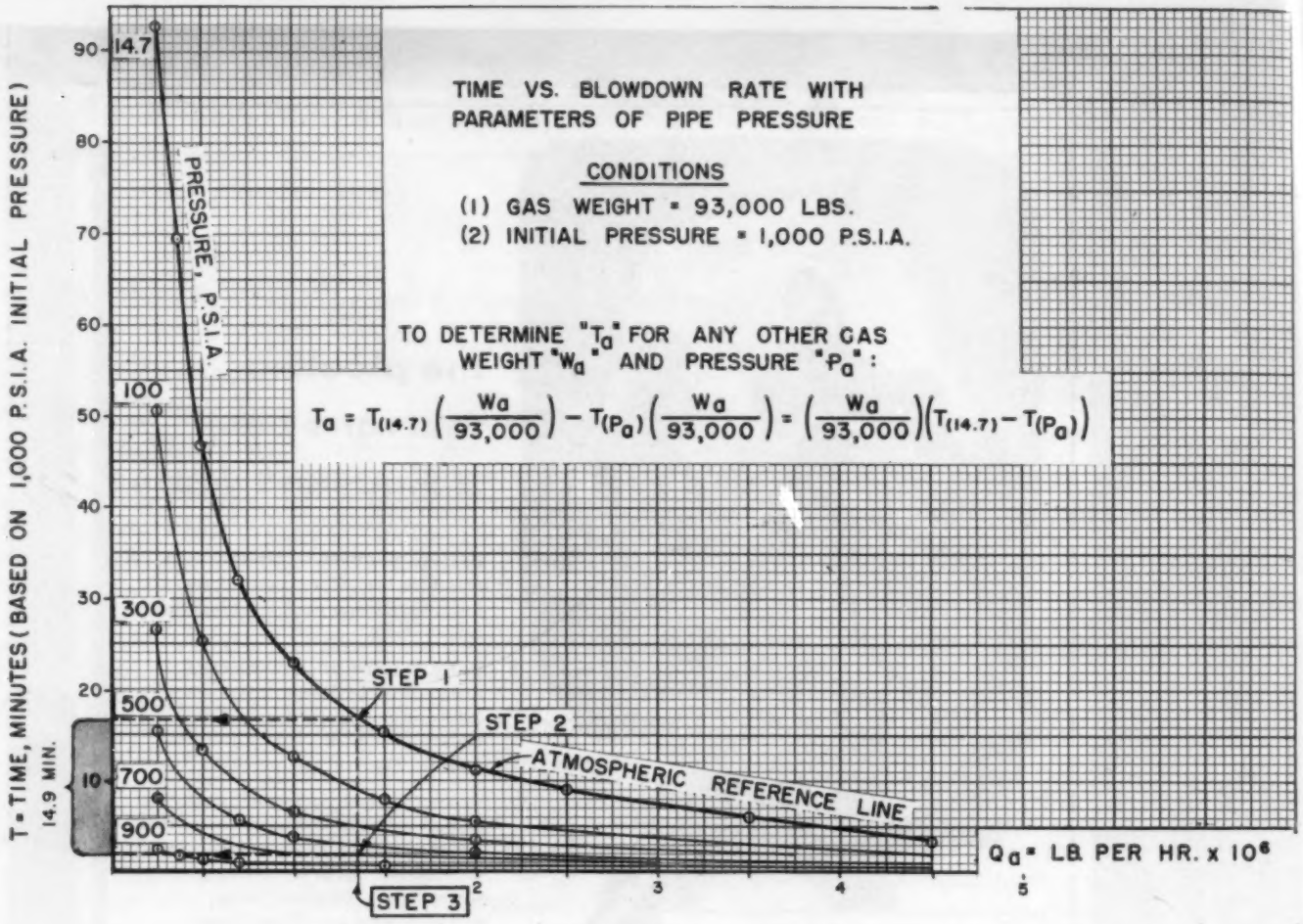

FIGURE 1

Use these charts to . . .

Find Exhausting Time For Gas Line Blowdown

Here is a graphical aid for designers who are confronted with the task of determining valve size and exhausting time for blowdown of gas pipe lines.

By TRACY S. PARK, JR., Tennessee Gas Transmission Company, Houston

WITH THE ADVENT of higher pressures in pipe line transmission systems, it has become increasingly important to provide adequate blowdown facilities for compressor stations, river crossings and main line sections. The hazards connected with blowouts are greatly reduced if designers have provided a means of rapidly venting high-pressure gas to atmosphere.

Engineers confronted with the task of designing blowdown systems will find Figures 1 and 2 helpful. They provide a graphical solution to the problems of determining valve size and exhausting time for the blowdown of gas lines.

First, a word of explanation regarding the use of the charts. All of the curves are based on blowing down a system with an initial pressure of 1000 pounds per square inch absolute. To determine the time required to blow down a system at, say, 640 psia, it is only necessary to find the

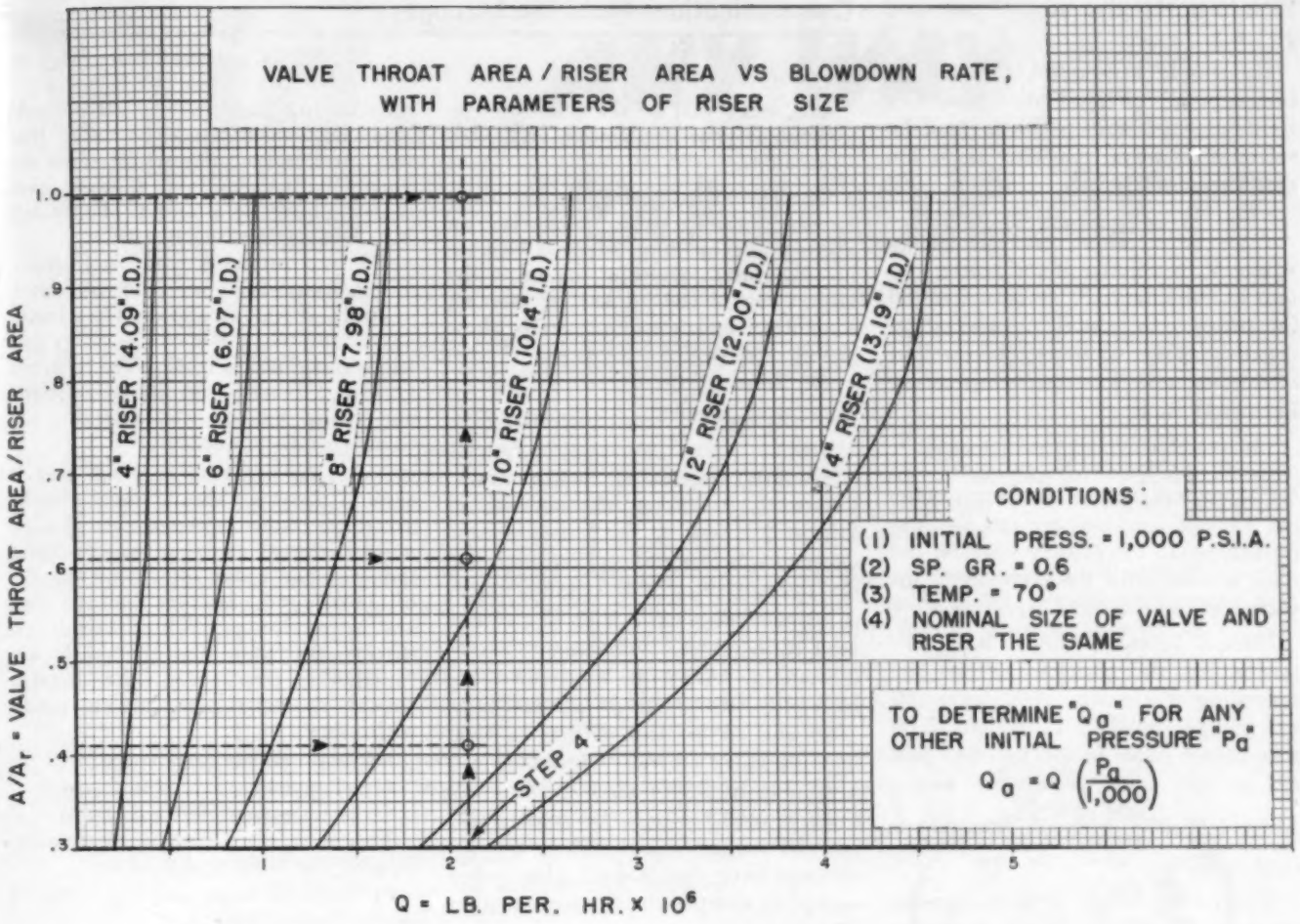
VALVE THROAT AREA / RISER AREA VS BLOWDOWN RATE, WITH PARAMETERS OF RISER SIZE
A/Ar = VALVE THROAT AREA / RISER AREA
Q = LB. PER. HR. x 10^6
4" RISER (4.09" I.D.)
6" RISER (6.07" I.D.)
8" RISER (7.98" I.D.)
10" RISER (10.14" I.D.)
12" RISER (12.00" I.D.)
14" RISER (13.19" I.D.)
STEP 4
CONDITIONS:
(1) INITIAL PRESS. = 1,000 P.S.I.A.
(2) SP. GR. = 0.6
(3) TEMP. = 70°
(4) NOMINAL SIZE OF VALVE AND RISER THE SAME
TO DETERMINE "Qa" FOR ANY OTHER INITIAL PRESSURE "Pa"
Qa = Q (Pa / 1,000)

FIGURE 2

time required to exhaust such a system from 1000 psia to atmosphere and subtract the time required to exhaust the system from 1000 psia to 640 psia. The difference is the time required to blow down the system from 640 psia to atmosphere.

Here is a definition of the terms used in solving the problems given as examples below:

Q = instantaneous mass flow of gas in pounds per hour at 1000 psia.

Q_a = the actual instantaneous mass flow of gas at the actual line pressure at the start of the blowdown.

W_a = the actual weight in pounds of the gas in the system at initial pressure prior to blowdown.

P_a = actual initial line pressure in psia.

$T_{(14.7)}$ = time that would be required to blow the system down from 1000 psia to atmospheric pressure.

T_{P_a} = time required to blow the system down from 1000 psia to the actual line pressure.

A/A_r = valve throat area divided by riser cross sectional area. Valve manufacturer's specifications provide a source for this information. As a rule, plug valves have a ratio of .4 to .6. Full opening valves, of course, have a ratio of 1.

Figure 1 is a plot of blowdown time vs. Q_a, with parameters of initial line pipe pressure. The curves are based on a piping system holding a static weight of 93,000 pounds of gas. (This is the equivalent of a system with a volume of 30,400 cubic feet filled with 1000 psia, .60 sp. gr. gas at 70° F.) Since the blowdown time is proportional to the weight of the gas exhausted, it is necessary to relate the weight of gas in a specific problem to 93,000 pounds in order to get on the curve. For example, if it takes ten minutes to blow down 93,000 pounds of gas through certain size valves, it would take 20 minutes to blow down 186,000 pounds of gas. Or conversely, to design a system to exhaust 186,000 pounds of gas in 20 minutes, design it to exhaust 93,000 pounds in ten minutes.

Figure 2 is a plot of A/A_r vs. Q, with parameters of riser diameter. The conditions set forth in Figure 2 will satisfy most pipe system applications with reasonable accuracy. Nominal size of riser and valve have been assumed to be the same, and it would be an unusual case if they were otherwise.

Sample problem and solution.

Problem: On a river crossing consisting of 3.123 miles of 26 x $\frac{3}{8}$-wall pipe, determine the size of blowdown valves which should be installed at each end of the crossing adjacent to the block valves, in order to exhaust the system in nine minutes. The pressure averages 640 psia.

Solution:

(1) If the time required to blowdown through two valves is nine minutes, the time required to blowdown through one valve would be 18 minutes. (2) Find W_a (the actual weight of the gas in 3.123 miles of

25¼-inch ID pipe at 640 psia and 70° F.)

By simple arithmetic, the volume of the pipe = 57,300 cubic feet. The remainder of the problem can be solved two ways; one way is to use this formula:

$$W_a = \frac{(V)\ (144)\ (P_a)}{RT}$$

where V = volume of the piping system in cubic feet; P_a = actual initial line pressure in psia; R = universal gas constant 1544 ÷ molecular weight of the gas; and T = gas temperature in degrees R.

$$W_a = \frac{(57{,}300)\ (144)\ (640)}{(1544 \div 17.37)\ (70 + 460)}$$

(Deviation factors have been omitted in this analysis due to the extremely small effect they have on the final answer, and the complexity involved if these factors were used.)

Here is an easier way to solve this portion of the problem: From the preceding discussion, 1000 psia, .60 sp. gr. gas at 70° F. weighs 3.06 pounds per cubic foot. Then 640 psia gas at the same conditions would weigh $3.06 \times \frac{640}{1000}$ or 1.96 pounds per cubic foot.

To find the actual weight of gas in the system multiply the volume times the weight per cubic foot:

$$W_a = 1.96 \times 57{,}300 = 112{,}300 \text{ lb.}$$

(3) In order to solve this problem graphically using the curves in Figures 1 and 2, it is necessary to relate the weight of the gas to 93,000 pounds. Thus if it is desired to blow down 112,300 pounds of gas in 18 minutes, determine the time required to blow down 93,000 pounds at the same rate. Since blowdown time is proportional to weight:

$$\frac{112{,}300}{93{,}000} = \frac{18}{\text{blowdown time}}$$

blowdown time = 14.9 minutes

Thus $T_{(34.7)} - T_{(Pa)} = 14.9$ minutes

(4) Find Q_a by locating a vertical line on Figure 1 such that its intersection with the Atmospheric Reference Line (see step 1, Figure 1) and an interpolated line representing 640 psia (Step 2) when projected over to the time ordinate will show a difference of 14.9 minutes. (Note that the shaded area at the lower left of chart intercepts 16.8 — 1.9 = 14.9). Observe that the actual mass flow (Step 3) on the abscissa is 1,350,000 pounds per hour. The mass flow just determined is Q_a shown in the equation of Figure 2.

(5) Solve for Q:

$$Q = Q_a \frac{1000}{P_a} = (1{,}350{,}000)\ \frac{1000}{640}$$

= 2,110,000 lb. per hr.

(6) Find the size of the blowdown. Locate 2,110,000 on the abscissa of Figure 2 (Step 4) and project upward to a horizontal line representing the desired type of blowdown valve. A 10-inch plug valve with 61 percent area ratio (A/A_r) will satisfy the requirements with some spare, or a 12-inch plug valve with 41 percent area ratio will more than suffice. A full-opening valve ($A/A_r = 1.0$) does not appear to be worth whlie in this case, since 8 inches would be undersized, and 10 inches would reflect no advantage over the 10-inch plug valve except to shorten the exhaustion time slightly.

Thus the solution to this problem calls for two 10-inch plug valves with a throat area of .61 percent to be installed at each end of the river crossing.

How to determine exhausting time for existing system. In order to determine the time required to blowdown an existing system, the procedure shown above is reversed: Start on Figure 2 with the valve throat area; project a line out to the valve size; and drop down to find Q. Solve for Q_a and locate it on Figure 1. Run a vertical line from Q_a and note the points it intersects the Atmospheric Reference line and the actual line pressure in psia.

From these two points draw lines to the left ordinate. The distance they intercept will represent the time such a system will require to blow down 93,000 pounds of gas. Next find the actual weight of gas in the existing system, and by proportion solve for the actual blowdown time.

In the range of gas transmission system pressures, this graphical solution gives reasonable accuracy.

—The End

Communications Make the Manager

Continued from Page 40

this letter will be the acknowledgement of your application for credit account.

The executive, gazing out his office window, vainly tries to devise an appropriate opening remark. Because his ingenuity fails him, he takes the easiest course (he thinks) by uttering sentences—noises—which really show no thought. The same executive would vehemently deny that he talks that way; and indeed, he probably does not goozle in conversation. Instead, over the telephone he would probably tell Mr. Jones something like this:

I'd like to thank you very much, Mr. Jones, for your letter of March 16, in which you applied for a credit account.

Little imagination is required to avoid goozling. Usually, avoiding goozling and being natural and friendly are complementary aims.

The executive who does not feel at ease in dictating should determine to avoid the old stereotypes, even though more natural expressions require thought. The worst sinners on the list of goozling expressions include "we are in receipt of" which means no more really than that the mails are functioning properly. The dictator should instead say, much more naturally:

"Thank you for your letter . . ."

Other goozling expressions are

"It is my earnest desire that you . . ."

This is a word-wasting expression. Instead, the dictator should say:

"I certainly hope you . . ." Or "I beg to inform you . . ."

Why should an executive beg anybody to do anything? Instead, he should simply inform his reader.

Even worse than occasional goozling (which shows merely that the dictator has not caught up with modern methods) is the rudeness some dictators unconsciously display. For example, the phrase "You claim in your letter . . ." seems harmless. But it casts doubt on the reader's veracity or sense of propriety. Equally as irritating is the implication that the reader has no sense of reason: "You ought to realize that we cannot extend open accounts to a customer with his first order." Perhaps the dictator must refuse to give the customer an open account; but the dictator should never insult an applicant. Rather, by subtle flattery, the dictator points out that his reader, as a businessman, knows the steps through which reputable firms, (such as the reader's) establish open accounts.

Final Test—Finally, the business letter must pass an acid test: Will it gain the desired results and still retain the reader's good will (unless the letter is the last of a collection series, of course)? If the dictator has carefully dictated the letter with the reader in mind; if he has trained his secretary to preserve the neat appearance

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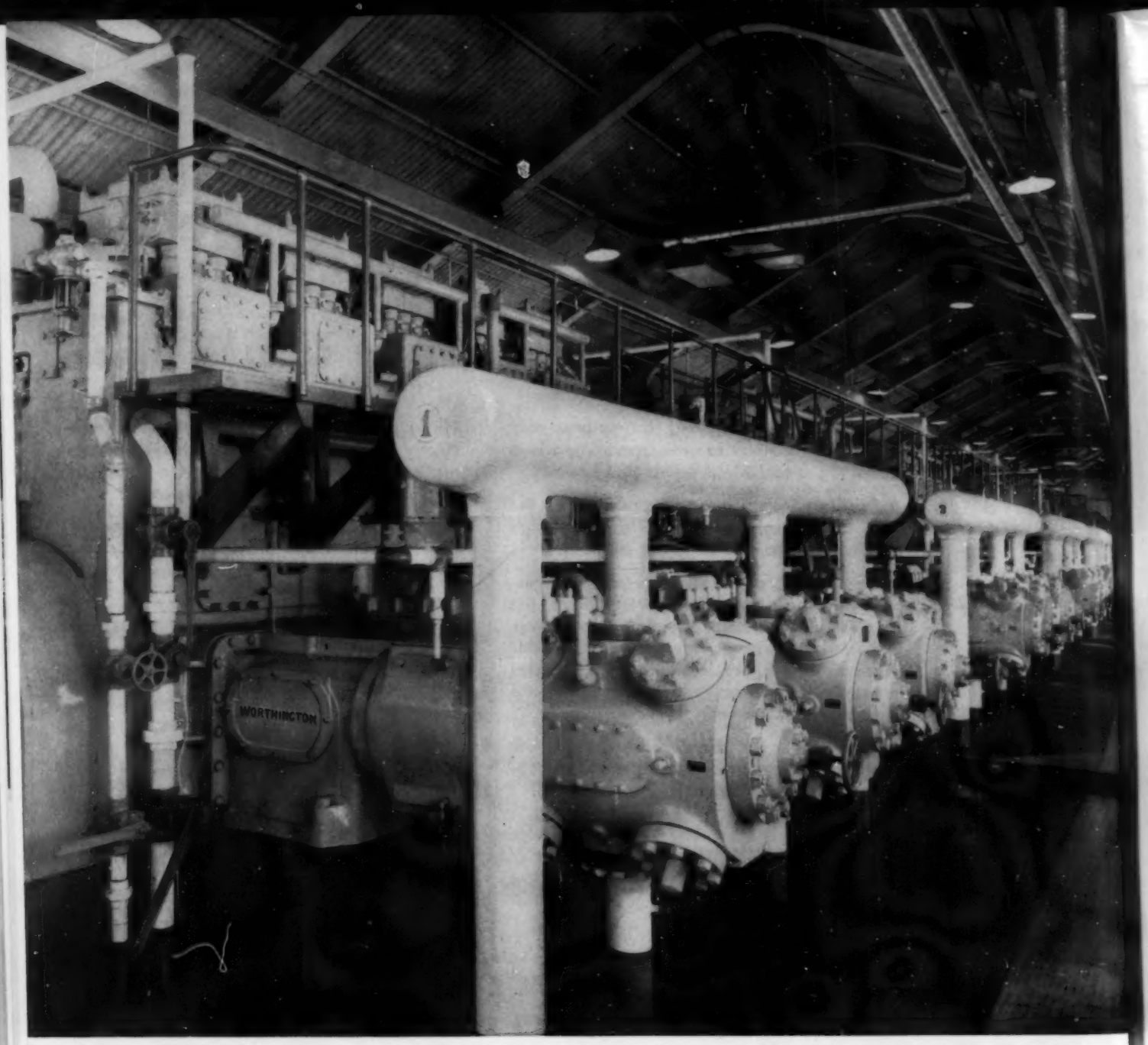
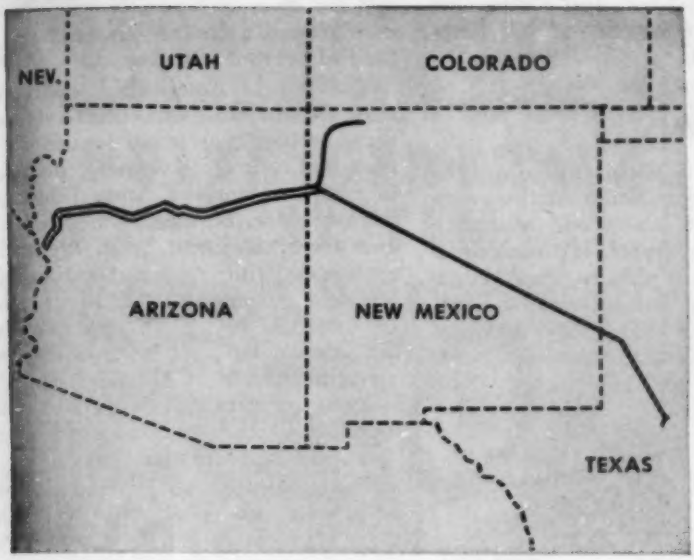
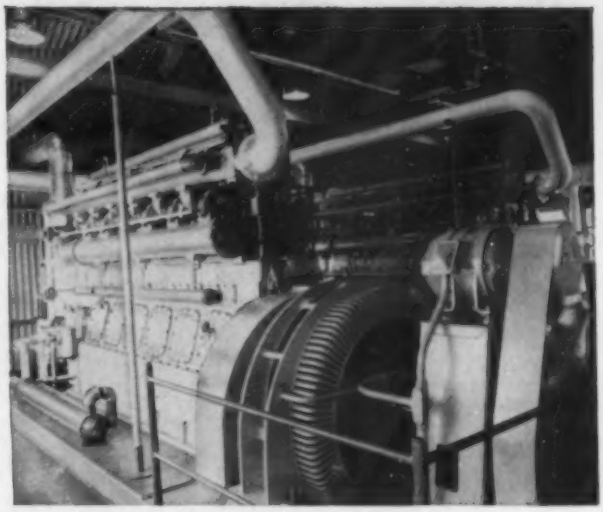


10,000 HORSEPOWER IS DELIVERED by these ten Worthington UTC Engine-Compressors in the Navajo Station on the El Paso Natural Gas line. Two 2000-hp Worthington UTC compressors are planned for the company's pending expansion at this station. They will handle a total of 687,000,000 cubic feet of gas when the installation is completed.

FEATHER* VALVE USED EXCLUSIVELY in Worthington compressors seats by contact, not by impact; ends remain in contact with the seat at all times. It operates quietly, efficiently, and with minimum maintenance.



PROPOSED 792 MILE, 30" PIPELINE to add 400 million foot capacity will run from the Permian Basin in Texas to Franconia, Arizona. The Navajo Station, largest in the line, will use a total of thirteen Worthington UTC Engine-Compressors.



ELECTRIC POWER for the Navajo compressor station is supplied by these two Worthington type CCG-6 gas engines which drive Electric Machinery generators. Such an economical means of generating power should not be overlooked when compressor stations are planned. Another CCG-6 is planned to supply additional power at the Navajo Station.

13 Worthington UTC Engine-Compressors planned for new El Paso Natural Gas line

The El Paso Natural Gas Company plans to install 13 Worthington Uniflo two-cycle engine-compressors on its new 792-mile line if the project is approved by the Federal Power Commission. These are in addition to the 18 units that the company already has in operation or in process of installation on this line.

The new 30-inch main transmission line will originate in the Permian Basin and extend in a northwesterly direction across New Mexico to a point near Gallup. There junction will be made with the existing 24-inch main transmission pipe line from the San Juan Basin. From that point west, the new 30-inch line will loop the present San Juan line to a point close to Franconia, Arizona, near the California border. This line will make possible additional deliveries totaling 400 million cubic feet of gas per day; 300 million cubic feet per day coming from the Permian Basin and 100 million cubic feet per day from the San Juan Basin.

The Navajo and Leupp compressor stations, first and second to handle the full 687 million cubic feet per day (the San Juan system is currently authorized for 287 million cubic feet per day) are both fully equipped with Worthington UTC Engine-Compressors exclusively.

Standard equipment on Worthington UTC's is the exclusive Feather* Valve—a factor that contributes materially to long life and trouble-free performance. The Feather Valve has long been recognized as the lightest, tightest, most durable and efficient valve obtainable.

While Worthington UTC compressors are widely used for pipeline gas compression, they are also well suited to many other jobs, such as pressure maintenance on oil wells; varied service in natural gasoline plants; solvent extraction, vapor recovery, and recycling and stabilization of gases in oil refineries.

If your business requires gas compression, it will pay you to write for further information on the Worthington UTC Engine-Compressor. Sizes range from 1,000 to 2,000 hp. Write to your nearest Worthington district office for Bulletin S-500-B23B. Or write directly to Worthington Corporation, Engine Division, Buffalo, New York. EK.3.2

*Reg. U. S. Pat. Off.

WORTHINGTON

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON

that every reader has a right to expect; if the letter is clear and concise with a minimum of wasted verbage; and if the letter will not offend the reader through unintentional implications; then the dictator may feel certain that it will be read and that it will probably get results.

Public Speaking Weighs Heavily

Probably every white-collar worker, as he starts up the ladder of management, observes incongruity between what he learned in high school, technical college, or university and what he observes in actual business practices. For, contrary to what most of his teachers may have said, technical knowledge of a job is not enough. Almost any organization employs men with plenty of brains and education who have only partially succeeded. Somehow, being able to speak effectively, among other qualifications, often weighs as heavily in promotion as do diligence, hard work, and skill. For American businessmen are talkers, and the American executive must be at ease around a conference table or on his feet in front of a group.

The typical American industrialist must be able to speak effectively because he speaks on many occasions. In the plant, office, or refinery, he talks to groups of workers. Around the conference table, he meets others of his own level; at lunch or at night, he associates with other executives in business and civic organizations. And because he has many opportunities for talking, he must be able to communicate effectively through speech. Discussions of communication must therefore include at least some comments about public speaking.

Any speaker should understand that before he can speak effectively, he must know just what his listeners expect. In a group meeting, in a conference, or on almost any occasion, the listeners expect that the man who is talking will display four characteristics:

Worthwhile information

A concise presentation

An interesting presentation

A logical approach.

A speaker must compete with distractions, the natural inattentiveness, the individual worries, and the limitations of listeners. Therefore, he must usually convey worthwhile information. (The industrial speaker seldom speaks to entertain.) Moreover, because the speaker competes with distractions and other interests, he must offer his facts and opinions concisely and interestingly; an audience will usually tolerate even disagreeable opinions, but it will not accept boredom. Finally, most listeners expect a logical approach to any serious subject.

Be Prepared—Nearly any speaker can meet these requirements by ample preparation. The speaker, before he arrives in the conference room, and certainly before he begins to speak, "gets his ducks in a row." If his discussion hinges on existing legislation, he checks the law or interviews his legal counsel. If his thoughts will concern past records, he checks his own or the corporate files. If he expects disagreement from his fellows or his subordinates, he plans to reconcile disagreements while he is talking. He never permits himself to appear unprepared. The speaker who "talks himself out on a limb" arouses at the best pity and at the worst scorn.

As in almost all communication, making an outline is a safe procedure in public speaking and conference

STOP CORROSION AND PARAFFIN PROBLEMS WITH TUBE-KOTE PLASTIC PIPE

Here's how to eliminate corrosion and paraffin problems on gathering lines — install Tube-Kote Plastic Pipe! No need to wrap or tape because Tube-Kote Plastic Pipe will never rot, rust or corrode!

Use Tube-Kote Plastic Pipe and you will eliminate all corrosion problems at one time. You will also eliminate paraffin deposition and save shut-down time and maintenance costs. You will have a better pipe that will last years longer.

You can transport Tube-Kote Plastic Pipe for less cost, and install it in less time, because it is only 1/6 the weight of steel pipe!

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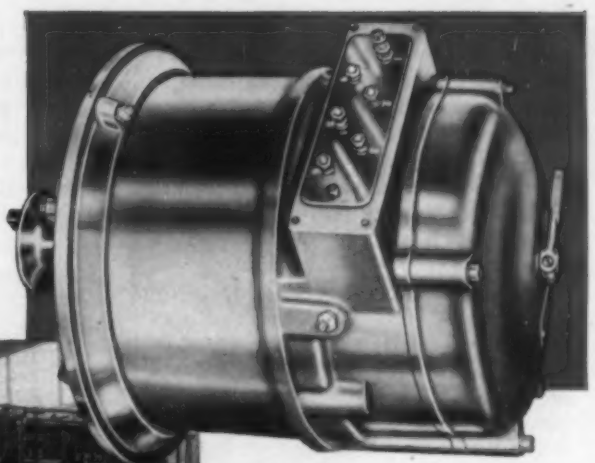
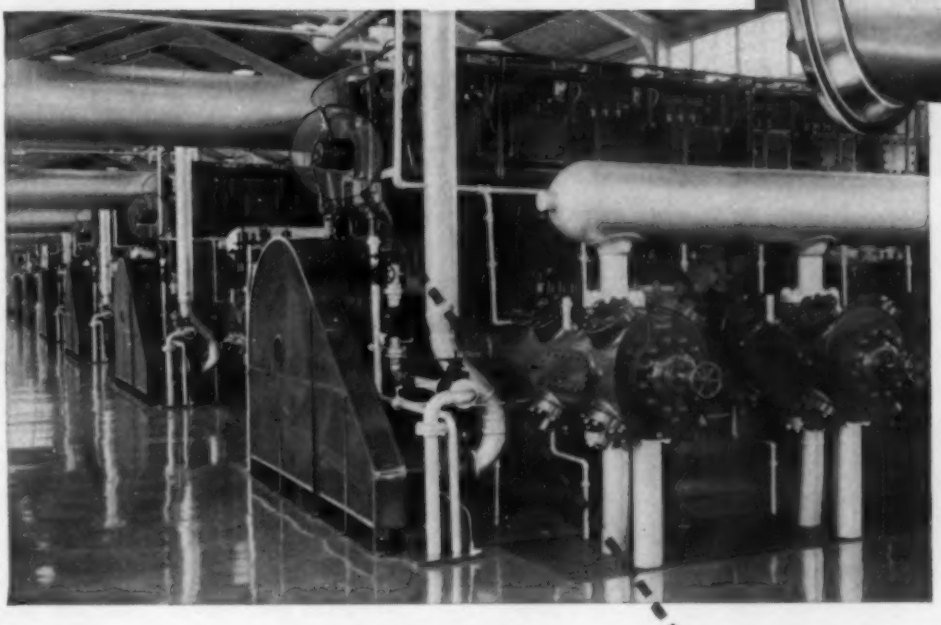




FOR TROUBLE-FREE IGNITION ON YOUR CONTINUOUS SERVICE GAS ENGINES!

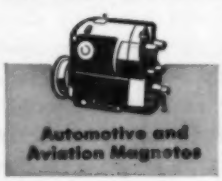
The first American Bosch Pulse Generator installation at the Michigan-Wisconsin Pipe Line Co. plant, New Windsor, Ill., ran constantly for 23 trouble-free months before removal for inspection. Subsequently, 18 engines in the Michigan-Wisconsin plants were equipped with the Pulse Generator System.

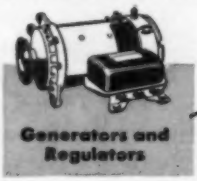
Here is the ultramodern Ignition System that is now saving time, trouble and money for many Oil Industry gas engine users. The new American Bosch MGC Pulse Generator System cuts maintenance costs and downtime caused by ignition troubles, provides constant, trouble-free operation over long periods—as shown in the case of the Michigan-Wisconsin Pipe Line Company engines pictured above.

This new Ignition System generates precisely timed, low-voltage, high-current pulses. Passed through the primary winding of oil filled transformers at each cylinder, these pulses generate high voltage in the secondary winding, more than enough to provide reliable ignition for very high compression gas engines (from the current 250-400 psi to all presently contemplated engines of far greater compression pressures). Ignition cables carry only low tension current—no corona loss, no danger of fire or explosion. Only moving part is ball bearing mounted rotor—no contacts or distributor to cause condensation and corrosion problems. And the MGC's big capacity spells better ignition *all ways*.

You can have this greater capacity for long-term, trouble-free operation . . . Specify the American Bosch Pulse Generator System for all large stationary gas engines. American Bosch, Springfield 7, Massachusetts.

AMERICAN BOSCH

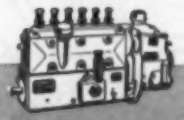

Automotive and Aviation Magnetos


Generators and Regulators

Components for Aircraft Engines

Electric Wipers and Small Motors

Ignition Coils


Diesel Fuel Injection Equipment

For more data on advertised products, use Readers' Service Cards, last page.

leading. An outline insures adequate preparation and a logical approach; an outline frees the speaker's mind so that he will probably present an interesting talk. To a conference leader his outline is most vital because it enables him to cover all the necessary subjects, to allot the proper amount of time to each subject, and to prevent the conference from disintegrating into an unproductive "bull session."

Any speaker, whether leading a conference or serving as the main speaker before a gathering, should try to avoid any irritating mannerisms. Mannerisms of voice control are especially difficult to overcome, but two other distracting habits can be easily avoided; the "and-er" habit and the habit of "fiddling" with keys or other gadgets. Anyone who habitually says "and-er" at every pause can enlist the aid of his wife or his secretary to help him cure himself of this habit. He may ask his wife or his secretary to whistle each time he says "and-er."

A speaker can avoid "fiddling with gadgets" by emptying his front pockets before he begins to speak. The speaker should put his change in his wallet and any keys or other gadgets in his back pockets. Besides curing the habit of distracting the audience by fiddling with gadgets, removing these gadgets will free a speaker's hands for effective gesticulation.

Finally, the audience wants a speaker to organize his thoughts before he begins to speak. Any educated audience rightly expects a speaker who consumes its time to assume an attitude of calm, confident competence.

Technical Writing, Worth a Premium

The growth of complex line and staff organizations in almost all industries has necessarily involved intracompany "paper-mills." Because in a large industry the individual department often functions almost as a separate business, executives frequently write communications between departments. Especially, top management passes along written orders and directives. This growth in paper work demands that countless hours of payroll time be spent in reading; consequently, top management in almost any industry places a premium on skill in technical writing.

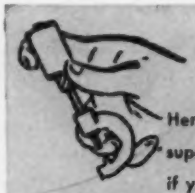
All technical writing, whether it represents recommendations, directives, job instructions, abstracts, progress reports, proposals, progress summaries, or investigation reports, should display four characteristics:

Conciseness and economy
Completeness
Logical order
Observance of grammatical and industrial conventions.

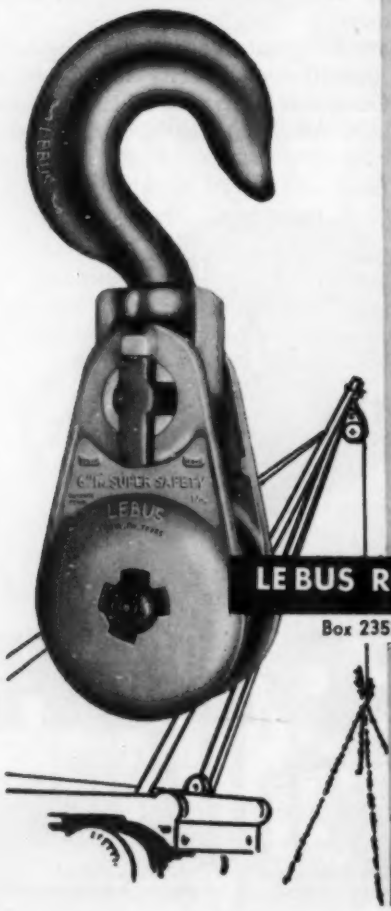
The advice to prepare an outline in planning any written or oral presentation of thoughts and facts applies even more to the technical writer's work. However, the outline assumes two stages in the technical report. First, the writer prepares a rough outline based upon what he already knows about his subject. This rough draft might be compared to the large scale chart a navigator of a ship uses before he begins to plot his detailed course.

After he has prepared his rough outline, the writer gathers his necessary data. Gathering his facts carefully will save the writer from embarrassment, for certainly nothing places a writer in a more unfavorable position than ignoring a pertinent company directive, a clause in an applicable union contract, a federal law, or a previous report. To help industrial writers, some plants maintain engineering libraries. *The Reader's Guide to Peri-*

PRECISION ENGINEERED LeBus snatch blocks



Here is a new block that is superior in every way. That is, if you are looking for a snatch block that is strong, tough, and dependable. One that you can rely on being constantly on the job regardless of how tough the job or how bad the weather. LeBus block requires no tools other than your hands, can be taken completely apart for oiling or other inspection and re-assembled in a matter of a few seconds, no nuts or threads to foul, burr or lose, is completely guaranteed against any failure which might be made in line with the manufacturers specifications. All parts are completely drop-forged, (no castings) heat-treated, quenched and drawn to make this snatch block fully reliable and dependable under any and all conditions of operations. The LeBus block is priced competitively and can be secured through any wholesale jobber throughout the United States. For further information write direct or have your supply source write for catalog page 1000 for complete information on the five sizes of LeBus blocks.



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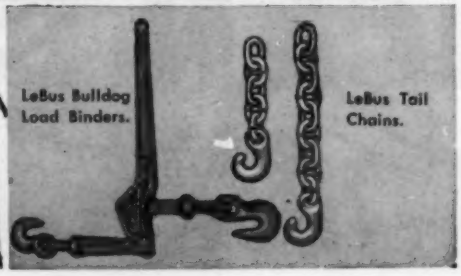

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odical Literature and bibliographies of governmental publications may also prove valuable. Finally, almost any technical report should involve a survey of the various company manuals and discussions with the concerned supervisors or foremen. Meticulous attention to the facts embodied in his report will earn for the writer the reputation of never going off "half-cocked"—of always organizing his facts.

Use Logical Order—His schedule usually permits the writer to make certain that this rough outline, in the light of his research, displays logical order. Nothing impresses a superior or a customer much more than does a report which evidences logical organization. If the report summarizes developments, the narrative form, with the details in chronological arrangement, usually serves best. A recommendation usually has this arrangement: recommendation, reasoning, answers to objections, and summary. Like the summary report, job descriptions or instructions should usually follow chronological order through a step-by-step account of what action the reader should take, with reasons given wherever possible.

Next, the writer prepares a rough draft. Beginning writers frequently slavishly observe the rules of grammar; and, indeed, observance of grammatical convention is expected of every responsible writer. But no writer should concern himself with grammar or the niceties of expression until he has completed a rough draft. In the rough draft, ideas alone should concern the writer. For instance, in the rough draft, if the writer inadvertently uses a plural verb with a singular subject, he should not divert his attention to correcting this minor error until he has completed his draft. A carpenter does not begin to plane a cabinet with 400-grit paper; he first will use a jackplane or heavy sandpaper. Similarly, the technical writer puts ideas down on paper and reserves the polishing of these ideas until he has written them.

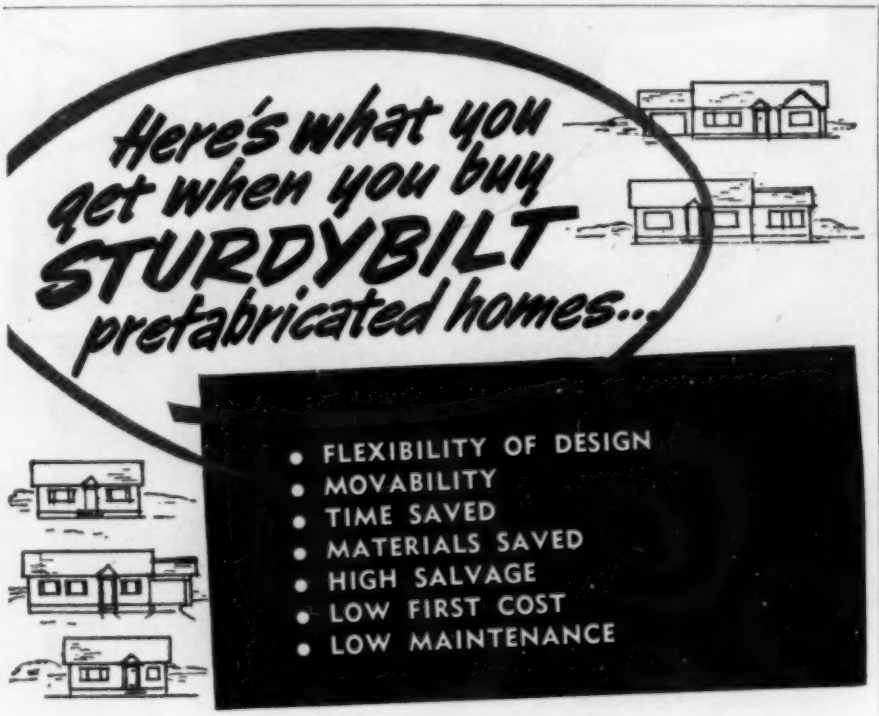
After he completes his rough draft, the writer edits it for conciseness of expression and for observance of convention. He should particularly try to eliminate all of the wasted words. For example, the following expressions usually have more economical equivalents:

Wasted words	Equivalents
In spite of the fact that	although
Because of the fact that	because
Can and will	will
In the checking of	to check
Should this contingency arise	if this happens
In any eventuality	always
Under these circumstances	therefore

Almost any piece of technical writing will be read either by a superior whose time is worth more than the writer's or by a group of subordinates whose collective time is valuable. Hence, the technical writer recognizes that rapid, sloppy writing usually means slow, costly reading. He never ignores the opportunity to omit padding or unnecessary phrases, for the best formal business writing is "long on ideas" but "short on words."

Of course, conciseness must not run to an extreme. Telegraphic English belongs in telegrams and not in reports to one's superior. The technical writer should not strive for conciseness by eliminating the necessary "a's," "and's" and "the's."

The number of drafts through which a writer puts his report will depend upon two considerations: the importance of the report and the amount of time he can devote to the report. In writing any important report, the writer needs sufficient time to prepare a second draft; for a second draft will give the typist a clearer copy from which to copy the final draft. No matter how many drafts are prepared, the writer must accept responsibility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Only *prefabricated* housing can give you all these features. That's why STURDYBILT Prefabricated Houses are best for all industrial housing. Let us tell you how STURDYBILT housing can help you get better homes, warehouses, and other buildings . . . faster and at lower cost.

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Norris men are at your service 24 hours a day, backed by a plant that has the most modern equipment and manufacturing skills acquired through 70 years' experience. When you order oil field supplies, whether sucker rods, polished rods, well heads, or tubular items . . . SPECIFY NORRIS through your supply store and take advantage of the extra service that is represented in the Norris sales and service staff.

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for the copy which is submitted.

The writer's responsibility is a subject which itself merits comment. Many writers in business assume an attitude of "I'll let my typist worry about that." Such an attitude is both unwise and unrealistic. For whoever aids in preparing the final draft, the report in its final form is the writer's inescapable responsibility. If the report contains typographical errors, or if the typist has juxtaposed ideas or sentences, the writer must accept whatever consequences may result. And, as most businessmen will testify, companies have too few sufficiently trained stenographers and typists. In fact, the amount of space devoted to "help-wanted" advertisements for secretarial help is exceeded in most metropolitan dailies only by advertisements for salesmen. Many firms are forced to employ typists whose training is only sketchy. A writer displays extreme naivete in assuming that a partially trained typist will correct all of her errors.

Timing Factor—As in nearly all other activities, timing is important in submitting a report. To submit a recommendation critical of present operations when the writer is not matching his own work schedule will probably earn a superior's disfavor. Taking care of first things first is sound advice.

Briefly, then a technical report must evince

Mature judgment
Careful marshalling of facts
Consideration of the reader's time
Preparation
Obedience to conventions
Proper timing

No matter how brilliant its conclusions, the report which does not show these qualities will probably fail of acceptance. And, conversely, even a report which cannot convince the reader of its conclusions and recommendations will merit the reader's respect if it does measure up to these criteria.

First Choice

for Continuous Duty Service

WISCONSIN
HEAVY-DUTY
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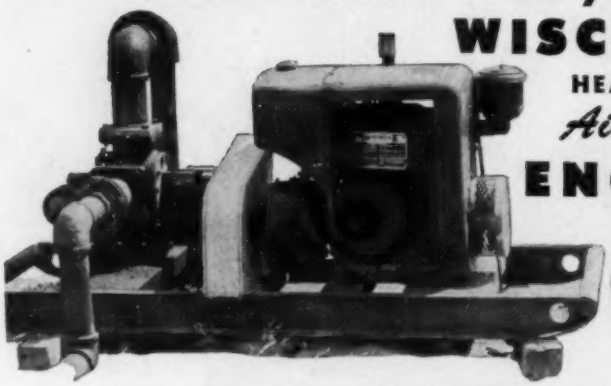


Power TO FIT THE JOB

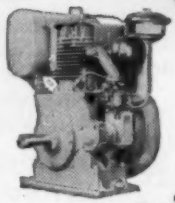
Power TO FIT THE MACHINE

Here's a job that calls for "what it takes" in an engine! Operating this 4-inch crude loading pump on a continuous, heavy-duty work-schedule calls for the kind of built-in stamina provided by Wisconsin heavy-duty engineered design and construction.

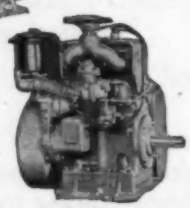
Wisconsin Heavy-Duty Air-Cooled Engines are universally accepted in the Oil Field for operating a great variety of equipment where dependable "Lugging Power" is called for. Connecting rods, crankshaft, power take-off shafts are constructed to withstand the most strenuous shock loads. And when these loads occur and the engine speed slows down, with a corresponding torque build-up, your Wisconsin *hangs on* and keeps the work moving.

Tapered roller bearings at BOTH ends of the crankshaft on ALL models, rotary type high tension Magneto mounted OUTSIDE where it is easily accessible and protected from oil and grease are among the features that assure dependable service. All models can be equipped to operate on kerosene, butane, propane or natural gas.

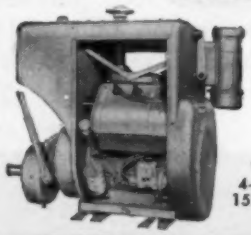
You can't do better than to specify "Wisconsin" for *your* equipment.



4-cycle single cylinder 3 to 9 hp.



2-cylinder models 7 to 15 hp.



V-type 4-cylinder 15 to 36 hp

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World's Largest Builders of Heavy-Duty Air-Cooled Engines

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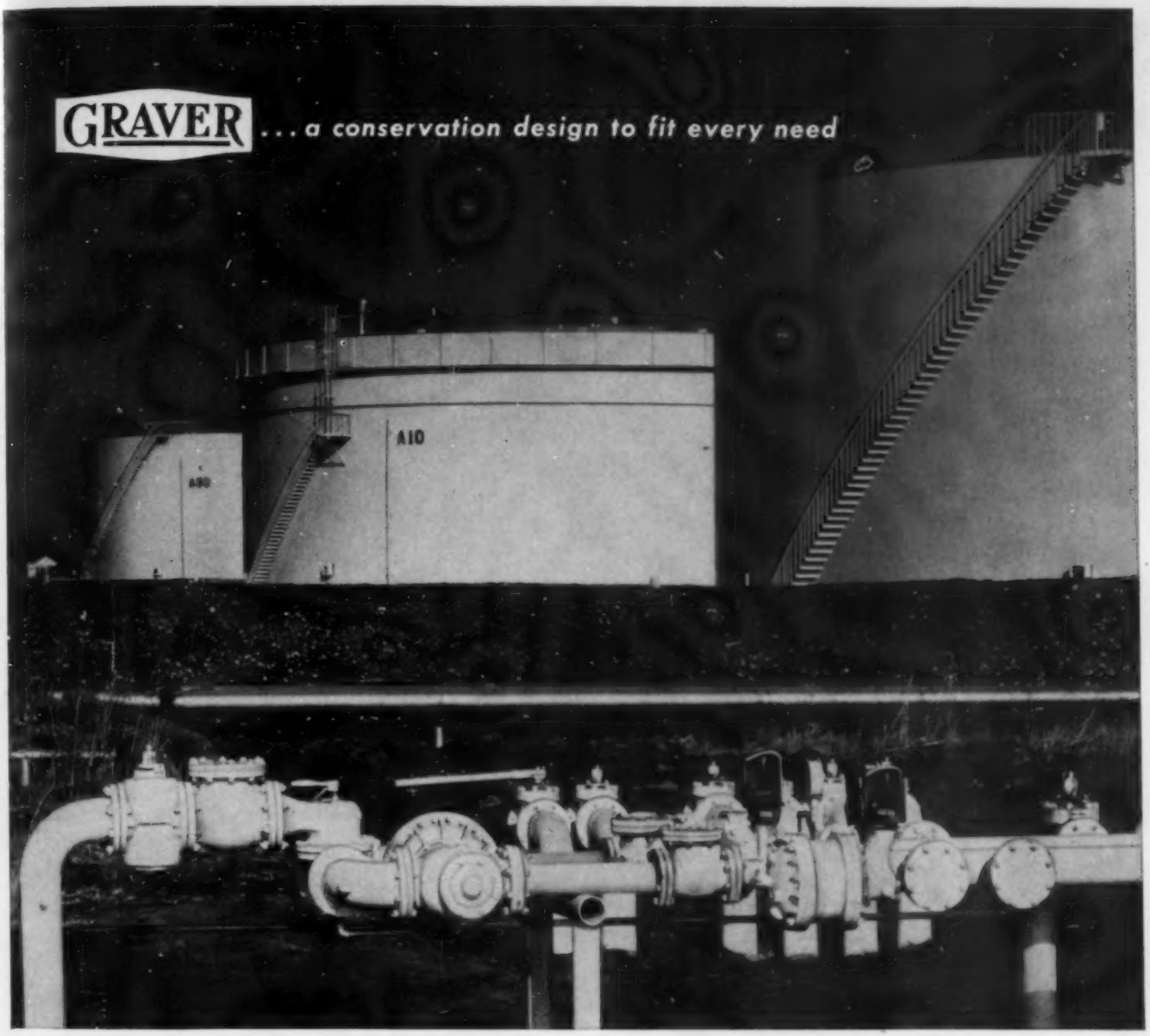
WHO'S MEETING WHERE

SEPT. 8–10	Mid-West Gas School and Conference, Iowa State College, Ames, Iowa
8–10	Pacific Coast Gas Association, Vancouver and Georgia Hotels, Vancouver, British Columbia
10	New Jersey Gas Association, Hotel Monmouth, Spring Lake, N.J.
10	SGA Compressor Station Operation Conference, Jung Hotel, New Orleans.
13	SGA Distribution Operating Conference, Henry Grady Hotel, Atlanta, Ga.
13–14	Independent Natural Gas Association of America, Roosevelt Hotel, New Orleans
15–16	American Gas Association, Sixth Annual Accident Prevention Conference, Bond Hotel, Hartford, Conn.
27–29	Electrical Conference of the Petroleum Industry, Petroleum Industry Committee of AIEE, Mayo Hotel, Tulsa
28–29	Texas Mid-Continent Oil and Gas Association, Baker Hotel, Dallas
30	SGA Transmission Management Conference, Shamrock Hotel, Houston.
OCT. 2	Southern Gas Association, Right-of-Way Conference, Peabody Hotel, Memphis, Tenn.
9	American Gas Association Board of Directors, Atlantic City, N. J.
9	Southern Gas Association, Natural Gas Roundtable, Rice Hotel, Houston
11–14	American Gas Association, Atlantic City, N. J.
14–15	National Association of Corrosion Engineers, South Central Region, Dallas.
NOV. 4	Midwest Industrial Gas Council, Fall Meeting, La Salle Hotel, Chicago.
8–11	API, Division of Transportation, Chicago
17–19	Southeastern Gas Association, Sir Walter Hotel, Raleigh, N.C.
17–19	Wisconsin Utilities Association, Electric and Gas Section, Technical and Sales and Service Division, Hotel Schroeder, Milwaukee.
28—Dec. 3	American Society of Mechanical Engineers, Statler Hotel, New York.



SHELL

IN CHICAGO
Premium Gasoline with TCP Goes to Market...
FROM GRAVER TANKS

The volatility of Shell Premium gasoline with TCP is safeguarded for Chicago area customers by this 140′ by 40′ Graver Expansion Roof tank—the largest tank of this design in the world.

Shell's Premium gasoline, with TCP added at Wood River, Illinois, is shipped by Shell's Products Pipe Line to the new terminal at Argo, where it is protected against vapor losses in storage by the Expansion Roof. The variable vapor space provided by the movable roof retains the vapors of the gasoline in this tank and in a similar Graver cone roof tank manifolded to it. Thus, the automatic action of a single Graver Expansion Roof is conserving the volatile elements of 9,200,000 gallons of Shell Premium Gasoline with TCP.

The completion of this particular tank is doubly significant, for now not only has Shell in operation the largest Expansion Roof ever built, but also the first Expansion Roof ever built. This early unit, erected in 1939, has operated unfailingly for the past 15 years. Such service records have made Graver Expansion Roof tanks the overwhelming choice of those most concerned with proper conservation methods.

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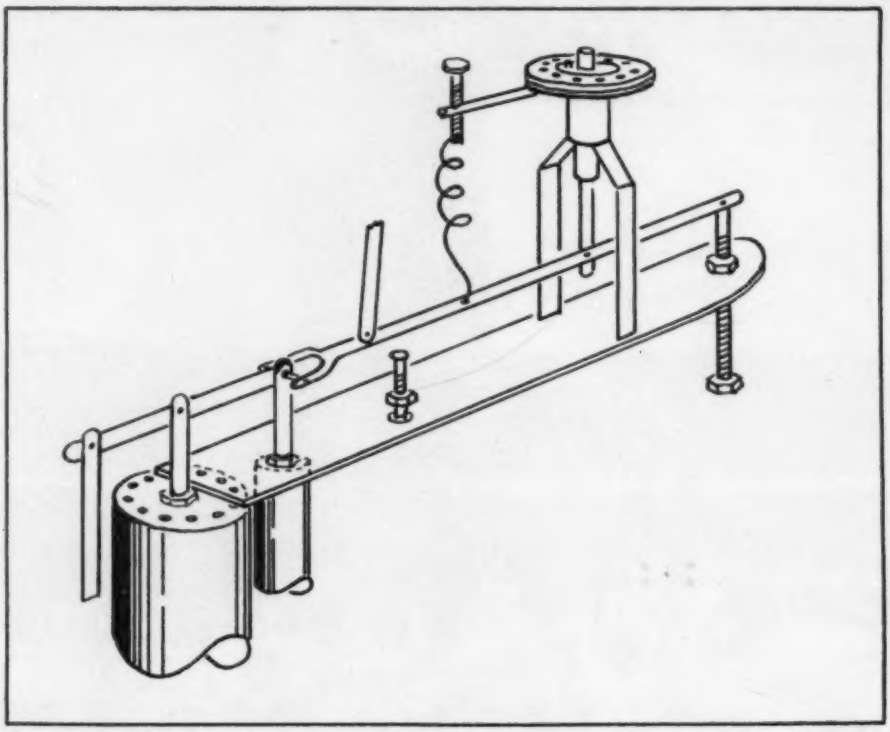
For more data on advertised products, use Readers' Service Cards, last page.

How to do it

PIPE LINE HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1, Texas



Butterfly Stops Fluctuation in Gas Load

High fluctuation in the gas load caused trouble at Arkansas Fuel Oil's Dorcheat-Macedonia vacuum compressor stations until this kink was worked out by maintenance and field men.

The problem was holding atmospheric pressure on the suction of the engines without some mechanical control. By pinching a suction valve and installing a governor booster, the trouble was partially eliminated. However, there was still fluctuation in the static pressure on a minimum and maximum load.

On a minimum load, line pressure was lowered below atmospheric, causing air to enter the line through leaks and causing excessive corrosion in pipe lines.

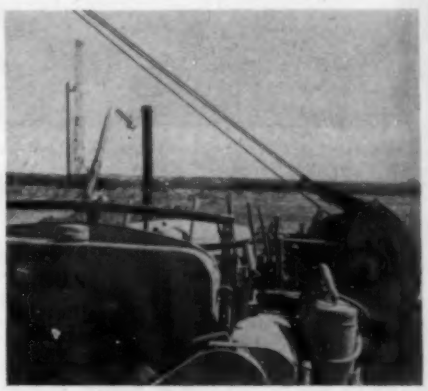
Thought was given to placing a regulator on the line to hold a constant pressure on the field, but the cost was too high. Then the maintenance and field teams installed a diaphragm regulator head to control, by field pressure, the mechanical governor above its set speed. The top of this diaphragm was connected to the upstream side of the meter run. The control was adjusted to remain at a closed position and have no control over the depression of the fly ball governor until the pressure on the inlet of the meter run exceeded three pounds. This was done by a fuel injector spring, as shown here.

Then a bypass was made around the valve on the suction of the engine and in this a diaphragm operated butterfly was installed. On the side of the butterfly an arm with a weight was attached, so that by moving the weight, it would increase or decrease the pressure required to operate the diaphragm which, in turn, operated the butterfly.

In a cut and try method, it was found that the best operation, because of the rapid change in gas load, was to set the mechanical flyball governor to control the engine at minimum speed with a minimum load, and the butterfly to operate as close to zero gauge pressure as possible. As the butterfly opened up (due to the increase in field pressure) to a wide open position, the increase in pressure across the meter run and separator would exert approximately three pounds on the governor booster, thereby increasing the engine to maximum speed.

After the load of gas had been decreased so that the pressure on the governor booster no longer acted on the flyball mechanical governor arm, the engine would come back to its minimum speed.

This item was a prize winning "Operation Kink" presented by T. O. Hamaker, Magnolia, Ark., at a Tyler, Texas, NGAA meeting.



Tractor Umbrella Support Is Simple to Construct

A simple support for holding the tractor operator's umbrella can be made of two angle iron risers on either side of the fuel tank with one-inch nipples welded on top for bearings. Through the nipples a three-fourths-inch pipe is run to support the upright, made of one-inch pipe. Set screws hold the tee-shaped pipe in position. A piece of three-fourths-inch pipe holds the umbrella base.

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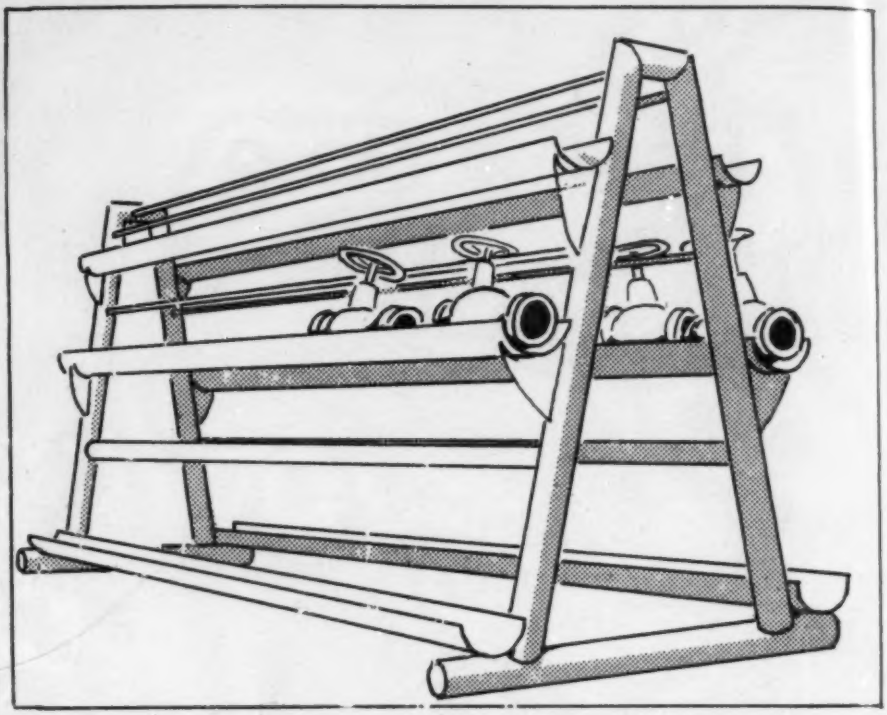
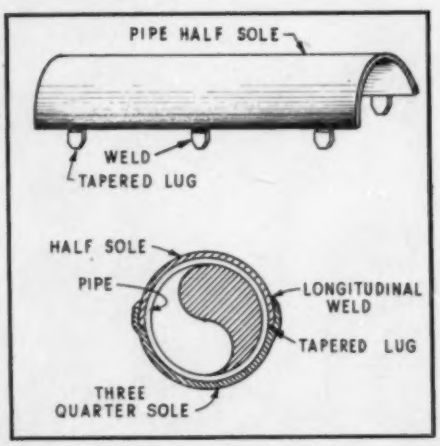


A-Frame Shelves Facilitate Valve Storage

Reconditioned valves can be kept conveniently available for inventory and selection by storing them in a central yard on an A-frame rack.

Construction of the rack is simple. A-frame type supports are welded to horizontal sections of casing which have been split down the middle. Each storage rack, measuring about 20 feet long, is made up of three A-frame members similar to the one shown above. The sloping legs of these frames support three horizontal "shelves" made from the split casing. The casing is mounted on the A-frame by welding a piece of plate steel webbing so that a saddle fits snugly around the bottom of the round casing section.

Valves of all sizes and types may be stored in the shelves for future use. The light-weight valves of smaller sizes might be placed on the top shelf, medium-sized valves on the middle shelf; and heavy, larger valves on the bottom shelf.



Weld Lugs to Pipe Sleeves To Facilitate Installation

The tapered lugs which are placed outside the pipe sleeve will guide it to its matching half-sleeve in a permanent repair job. Three lugs separated as shown are made of three-fourths inch plate which is the same material as the pipe sleeve itself.

Once the two halves are in place, weld the lugs to the opposite half-sole.

Scrap Materials Used In Gas Sample Bomb Holder

Holding the big gas sampling bombs in an upright position while charging the contents to a Podbielniak column can be troublesome. Here is a holder designed specifically for this purpose. It is made of scrap materials than can be found around almost any plant. These materials plus a small amount of a welder's time can make it easy to charge the gas from these big bombs to the column.

The size of the bomb makes an

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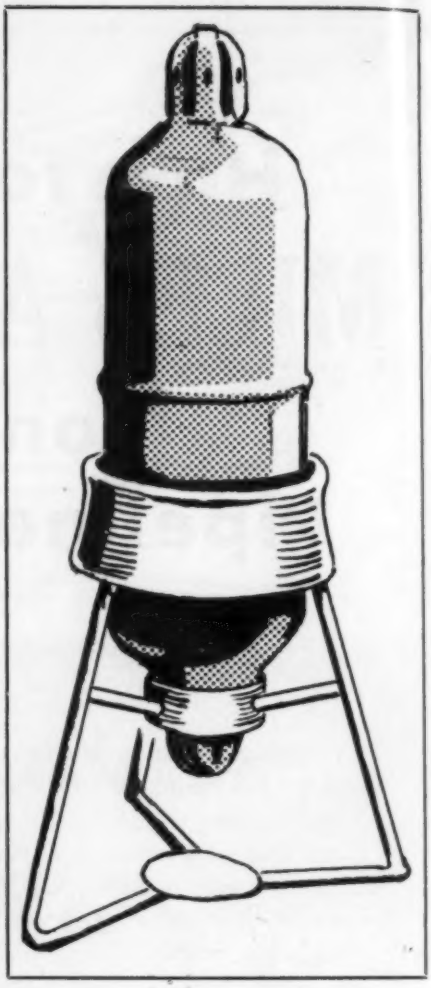
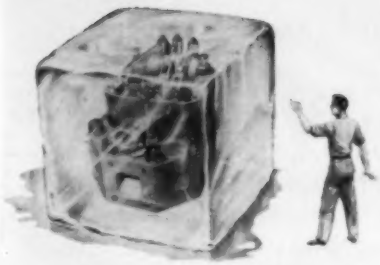


11-inch pipe thread protector ideal as the basic element of the holder. The supporting members for this protector are made from one-half-inch reinforcing rod. The rods are fastened to the protector and bent inward 12 inches from the bottom of the protector. The legs are then welded to a flat steel plate four inches in diameter. This arrangement gives the rigidity necessary to support the weight of the bomb without any danger of having the bomb topple over. A ring with an inside diameter of 4½ inches is welded to the legs below the pipe thread protector using the one-half-inch reinforcing rod. This ring fits over the bottom cap of the bomb and actually supports its weight while the pipe thread protector serves to hold the bomb upright. With the bomb in this position, the top cap can be removed and the charging line to the Pod column fastened to the valve at the top of the bomb. Painting the entire holder gives it a neat appearance.

This idea was submitted by W. F. Knighten, Jr., Carthage, Texas.



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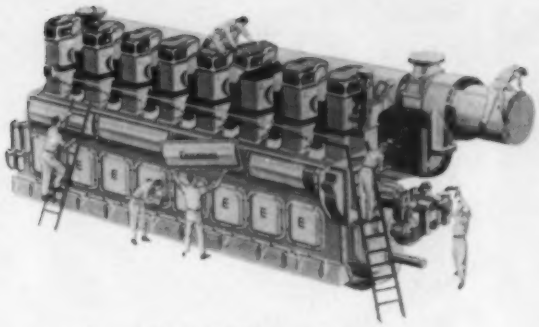

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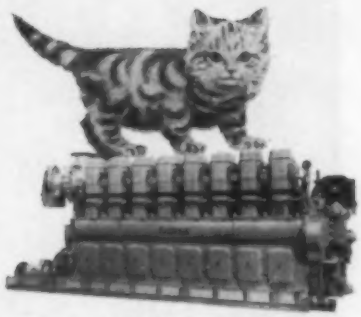

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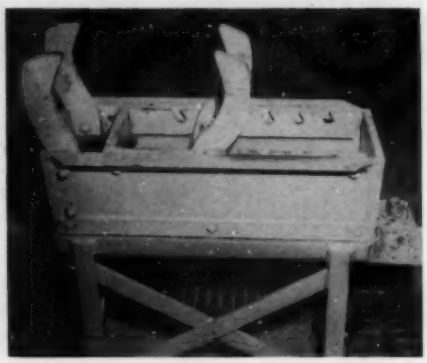


Adjustable Clamp Speeds Valve and Pipe Handling

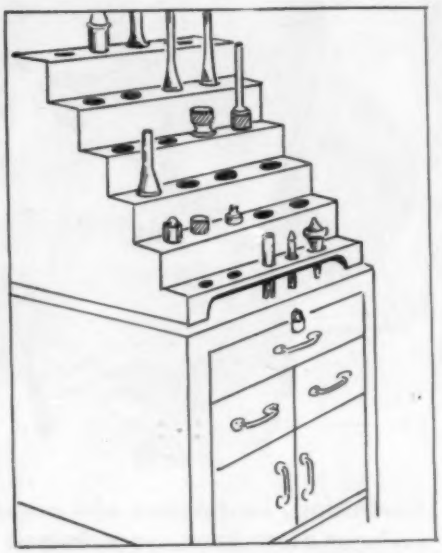
This shop-fabricated clamp, which has a variety of uses, is easily constructed from half-inch sheet steel. The clamps are adjustable for the size of material to be handled, which may vary from the extremes of control valves to six-inch pipe. The supporting table is notched at two-inch intervals to provide the major adjustment. The final minor adjustment is accomplished by the threaded screw shown.

The clamp foundation is four feet long by 18 inches wide. The clamp foundation is firmly mounted to a supporting table which is equipped with casters to ensure mobility in and around the shop.

Rack and Locker Provide Tools and Fittings Storage

A simple but effective arrangement for storing fittings used in horizontal drill presses can be set up as shown. All fittings are easily obtainable, and the arrangement contributes both to good housekeeping and efficiency.

Although the supporting rack for the fittings is made of wood, the locker below is of metal and is used for storing machine tools and other equipment issued to individual employes.



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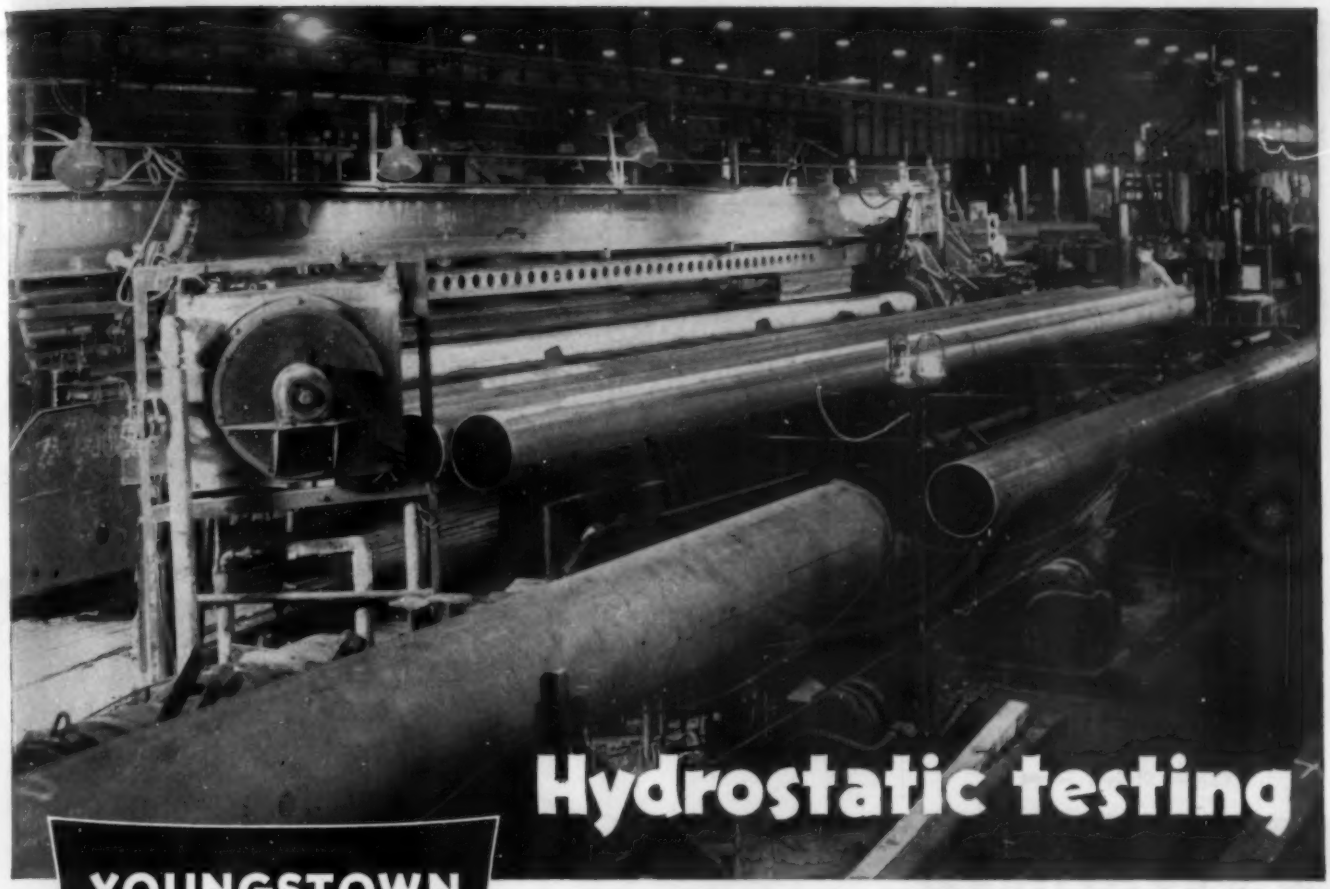

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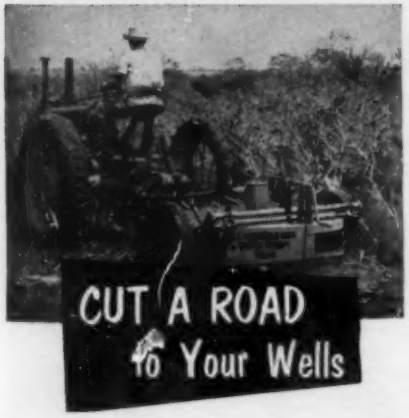

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WHAT'S HAPPENING

IN PIPE LINE CONSTRUCTION

By **MADELINE BYNUM,** Pipe Line Industry Staff

Western Is New Service Subsidiary

Formation of Western Pipe Line Co. to build and operate a new common carrier crude pipe line from the Rocky Mountain area to the Midwest has been announced by Service Pipe Line Company.

The new company, a subsidiary of Service, plans to have its 630-mile line in operation by the end of 1954. The line will run from Ft. Laramie, Wyo., to Freeman, Mo., near Kansas City. At Freeman the oil will be delivered into Service's big-inch system for transportation to refineries in the Kansas City, Wood River, and Chicago areas, and to other connecting lines.

The rapid development of new production in the Denver-Julesburg Basin of Colorado and Nebraska, the Powder River Basin of Wyoming, and other Rocky Mountain areas led to the decision to build the line.

From Ft. Laramie to Sterling, Colo., the line will be 20 inches in diameter; from Sterling to Natoma, Kansas, 22 inches; and from Natoma to Freeman, 24 inches. Initial capacity of the line into Freeman will be 160,000 barrels a day. It is being designed to handle more than 200,000 barrels daily with additional pump stations.

Until completion of the Western project, Service's present Ft. Laramie-to-Freeman line will remain in operation. Service's Wyoming system west of Ft. Laramie will continue to operate as at present.

Louisiana-to-Florida Gas Pipe Line Proposed

A 1,542-mile, 34-inch gas pipe line from Louisiana to Florida has been proposed by the Houston Texas Gas and Oil Company.

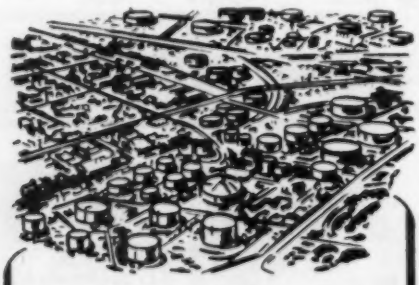
J. O. Mack, president of the company, announced that the Florida line

Pipe Line Contracts Not Let

COMPANY	Length in Miles	Diameter	Type	Origin and Terminus	Estimated Cost	Status
Alabama-Tennessee Natural Gas Co.	25	8, 12	Gas	Alabama	.....	Proposed
American Louisiana Pipe Line Co.—666 Penobscot Building, Detroit, Mich.	1,289	22, 30	Gas	Acadia, La.—Near Detroit, Mich.	$130 million	Proposed
American Pipe Line Corp.—New York City (Swinerton & Walberg, Engineering)	1,425+ 485 miles feeders & distribution lines	24, 26	Products	Beaumont, Texas, area—Newark, N.J.	$170 million	Out for bids
Anadarko Basin Pipe Line Co.	525	24	Gas	Wise County, Texas—Texas Eastern near Memphis, Tenn.	.....	Planned
Arkansas Louisiana Gas Co.—Slattery Building, Shreveport, La.	136	6-24	Gas	Loops along system to increase deliveries to 816 mmcf	$10,072,000	Authorized by FPC: 8½ miles already constructed
Atlas Corp.—Dresser Industries	400	16	Crude	Neuguen-Bahia Blanca, Argentina	$40 million	Planned
Badger Pipe Line Co.—Bartlesville, Okla.	196	8, 10, 12	Products	Chicago—Madison, Wis.	$15 million	One contract let
H. W. Bass & Sons Co.	152	4, 6	Products	Duval and Live Oak counties—Corpus Christi, Tex.	.....	Planned
California-Oregon Pipe Line System	103	6	Crude	Crescent City, Cal.—Medford, Ore.	.....	Planned
Carolina Natural Gas Corp.—701 Wilder Building, Charlotte, N.C.	185	2, 12	Gas	North and South Carolina	.....	Proposed
Central Hudson Gas & Electric Co.	48	12	Gas	Albany-Kingston, N.Y.	.....	Applied to FPC
Cheyenne Valley Pipe Line Co.	58	10	Crude	Lance Creek-Ft. Laramie, Wyo.	$1,838,241	Proposed
Cities Service Gas Co.—1st National Bank Building, Oklahoma City, Okla.	33	20, 26	Gas	To replace lines in Kansas and Missouri	$1,860,000	Authorized
	13	2-8	Gas	Cass and Johnson counties, Missouri	$146,000	Proposed
	13	.....	Gas	Labette County, Kansas	$285,000	Planned
City of Dalton, Ga.	39	8	Gas	To connect with Southern Natural Gas Co. line	$2,940,000	Proposed
Coast Counties Gas & Electric Co.—369 Pine St., San Francisco	40	3, 4, 8	Gas	Coast and Valley region, California	.....	Planned
Colorado Interstate Gas Co.—Colorado Springs, Colo.	365	22	Gas	Rock Springs, Wyo.—Denver, Colo.	$23,299,000	Authorized
	115	4, 6, 8	Gas	Denver-Julesburg Basin—Basin cities	.....	Before FPC
Colorado Western Pipe Line Co.—Dallas, Tex.	708	.....	Gas	Southeastern Colorado fields—Denver plus laterals	$30 million	Planned
	328	16, 18	Gas	LaPlata County—Pueblo, Colorado Springs, and Denver	$21,600,000	Authorized
Compania del Oleoducto Buenaventura—Cali, South America	90	.....	Products	Buenaventura—Cali, Colombia	.....	Planned
Dixie Pipe Line Co.	20	8	Gas	Gwinville Field, Mississippi-Transcontinental Gas line	$425,000	Proposed
El Paso Natural Gas Co.—Bassett Tower, El Paso, Tex.	32.5	.....	Gas	Reagan and Upton counties, Texas	$799,000	Authorized
	74	.....	Gas	Texas, New Mexico, and Arizona	$13,800,000	Proposed
Empresa Nacional del Petroleo	80	6	Products	Concon-Santiago, Chile	.....	Planned
Equitable Gas Co.—420 Boulevard of the Allies, Pittsburgh 19, Penn.	12	Various	Gas	Marion and Wetzel counties, West Virginia	$2 million	Authorized
Glacier Gas Co.	626	16, 20	Gas	Canada—Montana, Idaho, and Washington	.....	Planned
Gas Service Co.—Kansas City	12	.....	Gas	To connect with Cities Service Gas Co. line	$650,000	Planned
Governments of Southern Rhodesia and Portuguese East Africa	200	.....	Products	Beria, Portuguese Mozambique—Umtalia, Southern Rhodesia	.....	Considered
Home Gas Co.—Binghamton, N.Y.	32	12	Gas	Bresport—Union Center, N.Y.	.....	Planned
Hope Natural Gas Co.—445 W. Main St., Clarksburg, West Va.	33	8, 10, 12	Gas	Wyoming County, West Virginia—Buchanan County, Virginia	.....	Proposed
	22	12	Gas	Boone County, West Virginia—Logan-Mingo County line	$928,000	Authorized
	20	6-16	Gas	Gathering lines to fields	.....	Authorized
Houston Texas Gas & Oil Co.—4604 Main St., Houston	1,542	Various	Gas	Louisiana—Florida	$148 million	Proposed
Idaho Natural Gas Co.—Goodland, Kans.	.....	.....	Gas	Pacific Northwest line—points in southern Idaho	.....	Proposed
International Pipe Line Inc.—227 N. Colfax Ave., Minneapolis, Minn.	132	8	Products	Wrenshall, Minn.—Minneapolis Bulk Terminal	$4,250,000	Proposed
Kansas-Nebraska Natural Gas Co.—Phillipsburg, Kans.	221	6-12	Gas	Central and northeast Nebraska	$4,096,890	Authorized
Lateral Gas Pipe Line Co.—Cedar Rapids, Iowa	27	4	Gas	Grant—Clarinda, Iowa	$267,000	Proposed
Manufacturers Light & Heat Co.—Pittsburgh, Penn.	61	.....	Gas	13 projects in Ohio, Pennsylvania, and West Virginia	$4,099,250	Authorized
Mayflower Pipe Line Co.—(Pine Tree Natural Gas Co.—70 Pine St., New York, N.Y.)	200	.....	Products	New Jersey refining area—New England	.....	Planned
Michi Inc.	220	10	Crude	Highland, Ind.—Michigan refineries	$6 million	Has ODM certificate of necessity
Michigan Consolidated Gas Co.—415 Clifford, Detroit 26, Mich.	25.5	12	Gas	Sparta—Muskegon, Mich.	$13 million	Proposed
Michigan-Wisconsin Pipe Line Co.—500 Griswold, Detroit 26, Mich.	252	4-24	Gas	Wisconsin	$14 million	Proposed
Mid-Saskatchewan Pipe Line, Ltd.	23	8	Crude	Smiley Field—Kerrobert	.....	Proposed
Missouri Public Service Co.—Warrensburg, Mo.	136.4	8-10	Gas	New Flanklin, Mo.—Grundy County, plus laterals	$5 million	Proposed
Montana-Dakota Utilities Co.—Minneapolis, Minn.	56	2, 4, 6	Gas	Hettinger and Stark counties, North Dakota	$728,854	Authorized
	49	12	Gas	Montana and South Dakota	$1,366,944	Authorized
Moore Stoner Co.	200	6	Products	Glendive-Montana—Minot, N.D.	.....	Planned
NATO	1,920	4-10	Products	To serve military bases in Western Europe	.....	Foster-Wheeler prime contractor
Natural Gas Pipe Line Company of America—20 N. Wacker Dr., Chicago	240	24	Gas	Cater, Garvin, and Stephens counties—Hutchinson County, Texas	$30 million	Planned
Natural Gas Producers, Inc.—Colorado Springs, Colo.	100	12	Gas	Yenter Pool—Denver, Colo.	.....	Planned
Nebraska Pipe Line Co.	220	6	Products	Cheyenne, Wyo.—North Platte, Neb.	$4 million	ODM certificate granted
New River Gas Co.	50	.....	Gas	Sumners-Monroe counties, West Virginia, and Narrows Dublin, W. Va.	.....	Planned
NNCW Pipe Line Co.—Dallas, Texas	127	8, 10	Crude	Clareton Field—Casper, Wyo.	$3,600,000	Planned
Northern Indiana Fuel & Light Co.—Auburn, Ind.	35	10	Gas	Edgerton—Auburn, Ind.	$876,814	Planned
Northern Natural Gas Co.—2223 Dodge St., Omaha, Neb.	167	24	Gas	Farmington, Minn.—Duluth, Minn., and Superior, Wis.	$12 million	Before FPC
	329	2-12	.....	Sioux Falls—Aberdeen, S.D.	$6,661,100	Proposed
	310	24	Gas	Tioga—Fargo, N.D.	$18,494,000	Planned
	....	.....	Gas	To interconnect with Natural Gas Pipe Line	$244,000	Planned
North Dakota Natural Gas Co.—St. Paul, Minn.	500	6, 10, 12	Gas	Tioga, N. D.—Minot, Fessenden, Devils Lake, and Fargo, N. D., plus 6" feeder lines	$10,800,000	Proposed
Northwestern Utilities, Ltd.—10124 104th St., Edmonton, Alberta, Canada	42	12	Gas	Bonnie Glen—Edmonton, Alberta	$1,400,000	Proposed
Ohio Fuel Gas Co.—Columbus, Ohio	24.5	20	Gas	Richland and Crawford counties, Ohio	$1,072,000	Authorized
	46	20, 24	Gas	Jackson, Vinton, Hocking, and Fairfield counties, Ohio	$3,832,700	Proposed
	28	.....	Gas	Various Ohio counties	$832,700	Proposed
Orchard Pipe Line Co.—Denver, Colo.	45	8	Crude	Orchard—Merino, Colo.	$811,000	Planned
Pacific Northwest Pipe Line Corp.—M. & M. Building, Houston, Texas	1,466+ 380	Main	Gas	San Juan Basin—Pacific Northwestern states	$160 million	Approved
Pacific Western Oil Corp.—Los Angeles, Calif.	....	10	Crude	Neutral zone of Saudi Arabia to coast	.....	To construct as soon as practical
Panhandle Eastern Pipe Line Co.	575	.....	Gas	Kansas—Michigan	$67 million	Before FPC
	398	.....	Gas	Loops and laterals in Kansas and Michigan	.....	.....
Pawnee Pipe Line Co.	35	6-10	Crude	Adena Field—Merino, Colo.	$1,357,000	Approved
Pecos Growers Gas Co.	....	8	Gas	Grandfalls, Tex.—Reeves County, Texas	$2,500,000	Surveying started
Pembina Pipe Line Co., Ltd.—Calgary, Alberta, Canada	72	16	Crude	Pembina Field—Edmonton	$13 million	Permit granted
Petroleos Mexicanos—Avenue Juarez 94, Mexico, D.F., Mexico	440	20	Gas	Brasil—Tampico—Poza Rica, Mexico	.....	Planned
	260	6, 8	Products	Lagos, Mexico—Guadalajara, Aguascalientes, and Salamanca	.....	Planned
	145	12	Crude	18 de Marzo Field—Monterrey, Mexico	.....	Considered
	72	12	Crude	Poza Rica—Atzacapotzalco, Mexico	.....	Proposed
Phillips Petroleum Co.—Bartlesville, Okla.	52	10	Products	Shell's Brookshire system—Sweeney, Texas	.....	Planned
	54	6	Products	Goldsmith—Borger, Texas	.....	Planned

Pipe Line Contracts Not Let (Continued)

Pine Tree Pipe Line Co.	204	8, 10	Gas	Boston area—Bangor, Me.	.....	Planned
Pittsburgh Consolidation Coal Co.	100	.....	Coal	Cadiz, Ohio—near Cleveland, Ohio	$10 million	Planned
Powder River Pipe Line Co.—Casper, Wyo.	52	6, 8	Crude	Salt Creek and Casper, Wyo.	.....	Planned
Progress Pacific Pipe Line Co.—530 W. 6th St., Los Angeles, Calif.	1,100	24	Crude	Odessa, Tex.—Los Angeles Harbor	.....	Planned
Santos-Jundiai Railway Co.—Brazil	....	8, 14, 22	Crude & Products	Expansion of Santos—Sao Paulo system	$4 million	Planned
Shamrock Oil & Gas Corp.—1st National Bank Building, Amarillo, Texas	55	6	Products	McKee—Amarillo, Texas	$1 million	Planned
Shenandoah Gas Co.—Lynchburg, Va.	40	3, 4, 8	Gas	Virginia Gas Transmission Company system—Virginia and West Virginia towns	$1,470,000	Authorized
South Georgia Natural Gas Co.	368	2–12	Gas	Lee County, Alabama—Georgia and Florida	$8,969,000	Authorized
Sunflower Pipe Line, Inc.—Tulsa, Okla.	265	3–6	Products	Western Kansas—Wichita	$3,500,000	Authorized
Standard Oil Company of Texas	250	6	Products	El Paso, Tex.—Albuquerque, N. Mex.	$4 million	Planned
Standard Pipe Line Co.	350	16	Crude	Glendive, Mont.—Guernsey, Wyo.	.....	Planned
	330	16	Crude	Wink, Tex.—Albuquerque, N. Mex.	.....	Planned
Sturgeon Pipe Lines, Ltd.	100	12	.....	Sturgeon Lake Field—Trans-Mountain system	$6,500,000	Planned
Texas Gas Corp.—Shreveport, La.	3.5	12	Gas	Sabine River crossing to join Trans-continental Gas Pipe Line	.....	Authorized
Tennessee Gas Transmission Co.—Box 2511, Houston 1, Texas	50	10	Gas	Nueces County, Texas	.....	Proposed
	243	24	Gas	Hebron storage field, Pennsylvania—Greenwich, Conn.	.....	Proposed
Texas Eastern Transmission Corp.—Texas Eastern Building, Shreveport, La.	382	16, 24, 26	Gas	Reconvert "Little Big Inch" line and construct 382 miles of additional line	$71,114,000	Proposed
	58	16, 20	Gas	Joaquin—Longview, Texas	$3,269,000	Proposed
	....	.....	Gas	Reynosa, Mexico—Texas Eastern line	.....	Considered
Texas Gas Transmission Co.—416 W. 3rd St., Owensboro, Ky.	48	26	Gas	Lake Cormorant, Miss.—Slaughter, Ky.	$4,250,000	Proposed
	24	16	Gas	Acadia and Jefferson Davis parishes, Louisiana	$1 million +	Authorized
Trans-Canada Pipe Line, Ltd.—Calgary, Alberta, Canada	2,240	30, 36	Gas	Alberta—Eastern Canada	$297 million	Approved
Transcontinental Gas Pipe Line Corp.—3100 Travis St., Houston 6, Texas	....	.....	Gas	Connecting facilities with Texas Eastern-Penn Jersey in Pennsylvania and New Jersey	$131,628	Authorized
	533	30, 36	Gas	Paralleling portions of Texas—New York line	$80 million	Proposed
	25	12	Gas	Cameron and Calcasieu parishes, Louisiana	$1 million	Proposed
Trans-Northwest Gas, Inc.	246	.....	Gas	Osoyoos, B.C.—Washington and Idaho, plus 275 miles branch lines	.....	Planned
Triangle Pipe Line Co.	560	12	Products	Arkansas City, Ark.—Covington, Ky.	$24,500,000	Proposed
Union Gas Company of Canada, Ltd.—Chatham, Ontario	180	24	Gas	Dawn gas field in Lambton County to deliver gas to Dominion Gas Co.	.....	Planned
Union Oil Company of California—Union Oil Building, 617 W. 7th, Los Angeles 17, Calif.	65	12	Crude	Santa Clara Valley Field—Wilmington refinery	.....	Proposed
United Fuel Gas Co.	13	12,20	.....	West Virginia	.....	Before FPC
U. S. Army Corps of Engineers	600	.....	Products	Under study to supply military bases in Spain	$16 million	Planned
U. S. Navy	450	8	Gas	Gubik Field—Fairbanks, Alaska	$20 million	Proposed
Utah Natural Gas Co.	40	16	Gas	Orem—Salt Lake City, Utah	.....	Planned
Virginia Natural Gas Co.	153	.....	Gas	Buckingham—Richmond and Portsmouth, Va.	.....	Planned
West Coast Pipe Line Co.—Mercantile Bank Building, Dallas, Tex.	960	24, 26	Crude	Wink, Texas—Norwalk, Calif.	$106 million	Planned
Western Pipe Line Co.	630	20, 22, 24	Crude	Ft. Laramie, Wyo.—Freeman, Mo.	.....	Planned
Williston Basin Pipe Line Co.—Insurance Building, Omaha, Neb.	244	8	Products	Billings and Laurel refineries—Glendive, Mont.	.....	.....
Wyoming Gas Products Corp.	....	.....	Gas	Gathering system in Weston County, Wyoming, to feed gasoline plant	.....	Planned
Yacimientos Petroliferos Fiscales Bolivianos	170	4	Crude	Bermejo—Tupiza, Bolivia	.....	Planned



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will be constructed before two other large lines the company has proposed, one to Detroit and the other to New York City.

A market survey on the gas requirements of Florida was made by Barnard and Burk, consulting engineers of Baton Rouge, La. The survey shows that there is sufficient market in the area to justify building of the line.

The project will cost approximately $148,000,000 and include laterals for gathering and distribution of the gas to Florida cities. It will originate in the Louisiana gas field area south of New Orleans. Construction will begin when the FPC gives its authorization.

Standard Oil Building New Products Terminal

A distribution terminal will be built six miles southwest of Dearborn, Mich., by Standard Oil Company (Indiana) to supply products to part of eastern Michigan, including the western edge of Detroit.

The terminal, on a 53-acre plot near Inkster, Mich., in Wayne County, will be served by Standard Oil's new products pipe line running from the company's largest refinery at Whiting, Ind., 232 miles southwest, to River Rouge, 11 miles east. The pipe line runs through terminal property.

Construction has already begun, and the terminal is expected to be operating by December 15. It will run 24 hours a day and handle nearly 134,500,000 gallons of refined products yearly. Only trucks will be loaded there.

The region to be supplied by the new terminal includes, besides western Detroit, 19 Standard Oil bulk plants in an area reaching about 35 miles east and west and 80 miles north and south.

Arapahoe Awards Contracts For Colorado-to-Kansas Line

Arapahoe Pipe Line Company has awarded contracts for the construction of its 18- and 20-inch line between Merino, Colo., and Humboldt, Kansas. Construction will start immediately.

Pipe delivery will be completed by September 30. Offices for the project have been established in the Airport Buildings at Hutchinson, Kansas.

The capital stock of Arapahoe is owned by The Pure Oil Company

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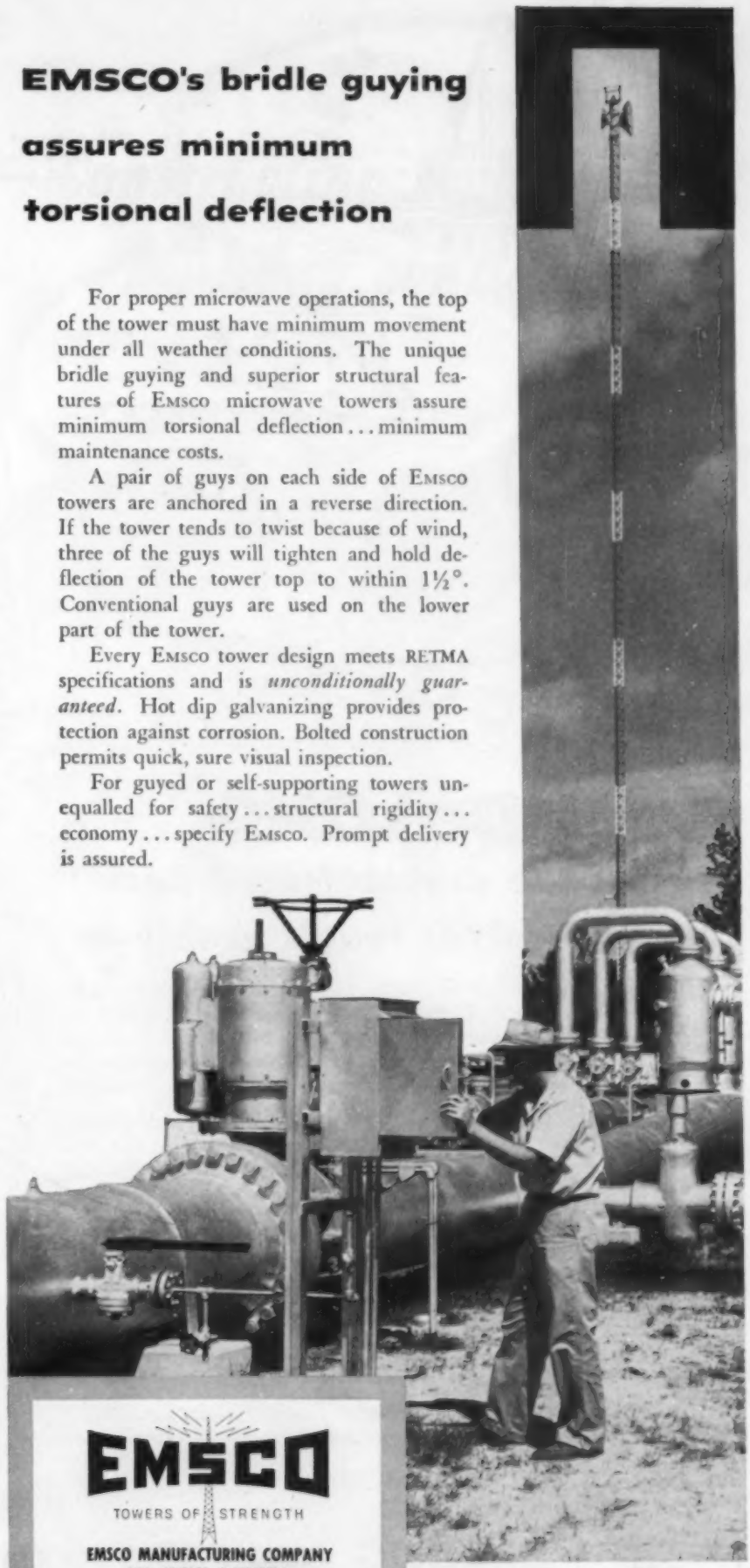

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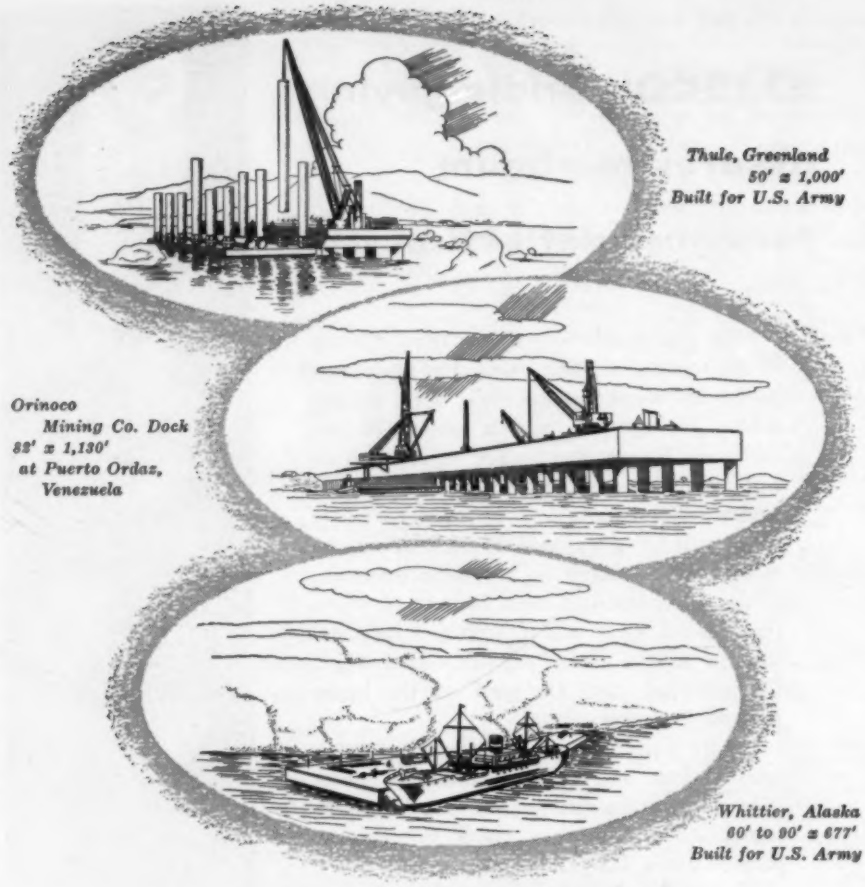

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and Sinclair Pipe Line Company. Sinclair will supervise construction of the line and will operate the system as agent for Arapahoe.

Success bidders for the project are as follows:

Section 1—149 miles of 18 inch—Merino to Colby, Kansas, R. H. Fulton and Company, Lubbock, Texas.

Section 2—162 miles of 18 inch—Colby to Schurr Station, Kansas, R. H. Fulton and Company.

Section 3—84 miles of 20 inch—Schurr Station to Burns, Kansas, R. H. Fulton and Company.

Section 4—86 miles of 20 inch—Burns to Humboldt, Panama-Williams Company, Houston.

Pecos Growers Gas Company To Serve Texas Farm Area

Pecos Growers Gas Company has been chartered to serve natural gas from the El Paso Natural Gas Company refinery near Grandfalls, Texas, to the irrigated pumping water wells of Reeves County.

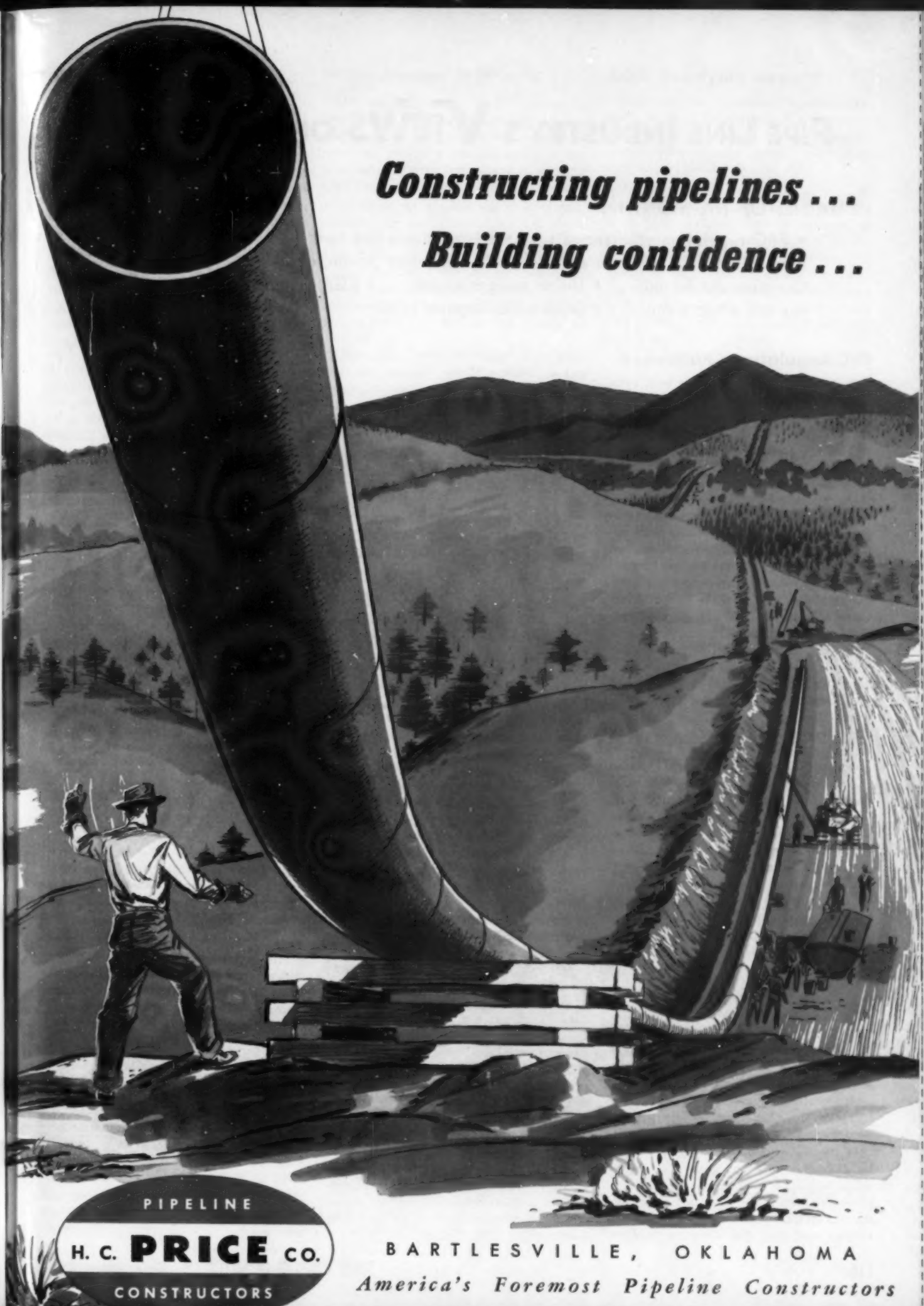
Construction of a pipe line is expected to begin as soon as engineering surveys are complete. First plans called for an 8-inch, 20-mile line, but the company has decided to extend the line somewhat farther north to reach a greater area. Extension plans boosted the total cost of the project to about $2,500,000, some $700,000 above the original estimate.

Interprovincial Completes 455-Mile Line in Canada

A fast-moving, 455-mile pipe-laying program along Interprovincial Pipe Line Company's Canadian section was completed September 1. The looping of the existing line with 24-inch pipe completes a full loop from Edmonton to Manitoba along the 16-inch and 18-inch original Interprovincial line.

In the United States, 184 miles of 26-inch are being laid in Minnesota.

Interprovincial's 1954 expansion program of $63,000,000 also includes five extensions to existing pump stations. Two new pumps and engines are being installed along the line between Edmonton and Manitoba, and footings for a third unit are being prepared. The 2,100 horsepower 1,000 revolutions per minute diesels and Bingham five-stage pumps are being installed in parallel to provide a maximum pressure of almost 1,000 pound per square inch.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PIPE LINE INDUSTRY'S VIEWS OF THE NEWS

HEADLINES OF THE MONTH

• FPC regulation challenged . . . • Denver Basin line to relieve lack . . . • Offshore bids delayed . . . • Texas ups allowable, compares production, reserves . . . • What Congress did for oil . . . • Union merger nearer . . . • AGA readying report . . . • How tax law affects you . . . • OGD needs experts

FPC Regulation Challenged

Federal Power Commission's new, drastic price-control regulations on natural gas —based on the Supreme Court mandate in the Phillips Petroleum Company case— seemed headed for a quick court referral.

Early last month The Ohio Oil Company and Magnolia Petroleum Company challenged the legality of the regulations and demanded the FPC hold public hearings on them before proceeding with enforcement. Gas industry circles said an FPC denial of the petition was certain and that it was equally certain the companies would appeal to the U. S. Circuit Court of Appeals in Washington, as provided when decrees of Federal regulatory bodies are contested.

The Ohio-Magnolia challenge was followed by petitions lodged by Humble Oil & Refining Company; Gulf Refining Company and Gulf Oil Corporation (together); Kerr-McGee Oil Industries, Inc.; American Producing Company; American Republics Corporation; Houston Oil Company of Texas; Tide Water Associated Oil Company; an individual, George J. Darnelli of California; Union Producing Company; Oil and Gas Property Management, Inc., Houston; Llano Grande Corporation, Houston; Eastern States Petroleum Company, Inc.; and individual Houston gas producers, H. S. Cole, Jr., and Frank W. Michaux.

The Commission had 30 days to accept or reject each petition. It meets regularly once a week but holds special sessions when major problems arise.

Magnolia and Ohio called the regulations illegal because they were issued without prior public hearings and said no formal notice was served on the thousands of independent producers affected. They said this deprived them of their rights, under contracts already in effect, to rate increases and changes in service without FPC approval.

In substance, this echoed charges made by FPC Commissioner Seaborn L. Digby when he filed a lone dissent to the commission's order. Digby said, in his opinion, the commission had exceeded its rule-making authority "in adopting this ex parte and unilateral order." He said it was a violation of the Natural Gas Act, jeopardized the rate structure of every company selling gas in interstate commerce, raised the spectre of countless lawsuits, and probably was unconstitutional.

A gas industry spokesman said he didn't want to try to "read minds," but he believed the challenge would wind up in the Appeals Court.

He said challenging companies "undoubtedly will exhaust all their remedies before the FPC before going to court" but that it must be kept in mind that the FPC is bound to enforce the Supreme Court mandate as the law of the land and therefore can be expected to deny the petitions.

When the Supreme Court reconvenes in October, it will have before it petitions from Phillips Petroleum Company and the states of Texas, Oklahoma and New Mexico for a rehearing in the Phillips case. Denials are certain unless the weight of accumulated evidence persuades the court that the issue requires another review.

FPC was handed one rebuff by Congress' refusal to appropriate $300,000 requested for additional personnel to administer the Supreme Court order. This lack of funds will delay processing of expected applications which probably will run into the thousands. Consequently, producers having bona fide claims for higher prices will not be able to get the prompt action assured them by the Commission when it froze the price of gas.

Meanwhile, President Eisenhower moved into the case indirectly when he appointed a special cabinet committee to study the nation's oil, gas and coal policies. Russell B. Brown, general counsel of the Independent Petroleum Association of America, said "it appears the study will cover the problem resulting from the new regulation of production of natural gas."

The same interpretation was placed upon it by a spokesman for Sen. Lyndon B. Johnson (D-Texas). After the Supreme Court's Phillips edict, Johnson wrote the President urging appointment of commission to study all ramifications of the decree and make recommendations for corrective legislation.

Eisenhower did not reply to Sen. Johnson directly but the White House said the whole field of energy, rates and consumption would be studied. The Committee must report by December 1, well in advance of convening of the 84th Congress which will receive many bills to overturn the Supreme Court ruling.

Mountain Carrier Planned

Rapid-fire development of new production in the Denver-Julesburg basin of Colorado, Nebraska, Wyoming and other Rocky Mountain areas has resulted in plans for a 630-mile common carrier crude line.

Stretching from Ft. Laramie, Wyo., to Freeman, Mo., the 20-22-24-inch, 160,000 barrels daily pipe line will be built and operated by Western Pipe Line Company to help alleviate a transportation lack that has been a deterrent to further production gains.

Western was formed as a subsidiary of Service Pipe Line Company.

The basin's pyramiding crude yield has risen from slightly more than 600 barrels a day a decade ago to more than 80,000 barrels now.

Western will deliver crude to Service Pipe Line's big-inch network for movement to refineries at Kansas City, Wood River and Chicago, as well as to other connecting pipe lines.

Law Delays Offshore Bids

A recently-passed Louisiana law has delayed the Interior Department's original listing of offshore areas to be made available for lease bids.

The list, filed with the Federal Register August 18 and withdrawn shortly afterward, will be withheld due to a possible controversy with Louisiana over a law establishing state boundaries beyond the three-mile limit sought by the federal government. Consequently, changes may be made in the federal boundary, affecting areas up for lease.

It is now up to the administration and government attorneys to decide upon the next move.

Texas Allowable Upped

In a brief—in minutes—but thorough—by appraisal—proration hearing August 19 at the state capital, the Texas Railroad Commission:

- Hiked the daily crude allowable 67,235 barrels from allowables averaging 2,725,041 barrels in the week ended August 14 by setting September's permissive flow at 15 days for most of the state.
- Issued a comparison of wells, crude production and reserves of Texas and neighboring states.
- Summarized nominations for Texas crude for six months' period beginning September, 1954.
- Reported crude purchasers' statements concerning their imports of crude and products into the U. S.
- Tabulated replies of Texas crude purchasers concerning crude purchased in Texas and neighboring states.

To compare Texas production of crude with that yielded by neighboring states, the Commission offered the following estimate for comparison as of July 24:

STATE	Indicated Average Daily Production Per Well	Percent of U. S. Production	Percent of U. S. Reserves
Texas	17.12	41.74	51.82
Oklahoma	7.73	8.12	6.05
New Mexico	28.48	3.30	2.82
Louisiana	43.98	10.16	9.53
Kansas	9.82	5.41	3.16
	....	68.73	73.38

What Congress Did for Oil

Republican-controlled 83rd Congress, kindly disposed to the oil industry in many ways, left its successor several knotty issues, including imports and federal control over field prices of independent gas producers.

But favorable to the industry were the 83rd's decisions to:

1. Give coastal states control of submerged lands out to their historic boundaries;
2. Exempt local natural gas distributors from Federal Power Commission regulation;
3. Authorize uranium development of public lands covered by oil and gas leases;
4. Triple amount of public lands in any one state which one person or a group can hold under oil or gas lease, to double the amount of land which may be held under option, and to raise the option period from two to three years;
5. Give the Interior secretary more discretion in cancelling leases on non-productive acreage and in determining drainage from federal lands by wells of adjoining drillers.

Union Merger Is Nearer

Oil, the last major U. S. industry to avoid a nationwide labor organization, had moved a little nearer this month toward the grip of a union ranking in size with the CIO's ten largest, and in strength with the big steel and auto organizations.

At Washington, after ten days of talk, rank-and-file committees of the Oil Workers International Union-CIO and the United Gas, Coke and Chemical Workers Union agreed on a tentative constitution for a new union which would have a membership of almost 200,000, approximately twice the size of the present oil workers' union.

The chemical workers will meet in St. Louis September 13 and the oil workers in Cleveland November 15 to ratify a constitution after acting on their differences, which are believed to be largely a matter of organizational structure and electoral procedure.

There was no apparent opposition to the merger at the Washington conclave, and no serious difficulty is expected at the St. Louis session. Most of the officers of both unions favor the merger, though Cecil Martin, secretary-treasurer of the chemical workers, has led a dissident segment. Martin, however, has been quoted as saying he will abide by the final decision and oppose the merger only in "principle."

(In a recent edition of his union's newspaper, Martin wrote: "To date, no one has advanced any argument which has in any way convinced me that the proposed merger is necessary."

(He pointed out that the chemical workers would stand to gain little—and perhaps to lose much—by uniting with OWIU. He also cited differences in operational procedures and expenses of the two unions, pointing especially to OWIU's per capita tax of $1.45, compared with $1.25 per capita tax of chemical workers.)

If both unions agree on the new organization, a merger meeting would be called, presumably about the time that O. A. (Jack) Knight, OWIU president, believes his organization will merge with independents under the Philadelphia plan—which is early next year.

Knight declared at Washington that efforts to merge OWIU with the chemical workers should help bring about a merger between OWIU and the independents. In this opinion he was not entirely in agreement with some of the independents, who are already wary of being "swallowed up" by the larger OWIU.

It was apparently to better his union's chances of merging with the independents that Knight last month attempted to hasten favorable action on his union's demands for a 5 percent wage hike.

AGA Readying Report

American Gas Association is developing under its PAR Plan a new Gas Measurement Committee Report No. 3 to supplement—and eventually replace—the widely used Report No. 2.

The new report will be a larger and more comprehensive version of Report No. 2. It will include research findings of AGA and others on the effect of forged elbows, plug valves, orifice fittings, tap locations, etc., and the comparison testing of 30-inch meter tubes. Wider range tables will make the report more useful, and added tolerance data will be included, where possible.

Not heretofore available, means of calculating supercompressibility factors will be included, but available in separate covers. This basic data from which the factors can be calculated has been released by seven gas companies sponsoring the work at the University of Ohio under direction of Professor S. R. Beitler.

The new report, expected to be available in 1955 from AGA, is sponsored by the Pipeline Research Committee, with J. T. Innis (Northern Natural Gas Company) chairman, and is under direction of the Supervising Committee for New Measurement Report, J. E. Overbeck (Columbia Gas System Service Corporation), chairman.

Suppliers to Work with U.S.

To abet the government mobilization work program, a contingent of representatives from many oil field machinery and equipment companies have agreed that the industry will report production statistics to the government.

It is expected that final drafting of the report form, company approval and, finally, government officials' OK will require at least two months.

Meeting with the Business and Defense Services Administration last month, when the reporting agreement was reached, were R. G. Ayres, Bovaird Supply Company, Tulsa; Earl Cobden, Hughes Tool Company, Houston, chairman of the company group at the Washington meeting; J. P. Desalle, Schlumberger Well Surveying Corporation, Houston; Howard Drake, Oil Well Supply Company, Dallas; W. H. Larkin, Larkin Packer Company, St. Louis; George Oller, Parkersburg Rig & Reel Company, Parkersburg, W. Va.; Charles Reichert, National Supply Company, Los Angeles; F. B. Reybold, American Locomotive Company, Beaumont, Texas; H. R. Safford, Petroleum Equipment Suppliers Association, Houston; John L. Tulles, J. B. Beaird Company, Shreveport.

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The Biggest Gas Line Ever Built

IN THE MOJAVE DESERT east of Barstow, California this Cleveland "320" Trencher is making the final cut, 4-ft. wide, 7½-ft. deep, for Pacific Gas and Electric Company's 34" "Super Inch" pipeline—reportedly the largest gas transmission line ever built.

On nearly every major pipeline construction project throughout the world you'll find Cleveland trenchers setting the pace. And on the majority of smaller trunk lines, gathering lines, lease lines, etc. you'll find Clevelands leading the way too. Pipeliners, large and small, will tell you Clevelands are *"Good . . . Everywhere"* because they dig *more trench—in more places—at less cost.*

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CLEVELAND

How Tax Law Affects You

The experts went ferreting into the towering and technical structure of the new tax law last month and fingered out the four provisions of greatest import to the industry.

1. Expensing of intangible drilling costs.

The measure makes it clear that oil and gas producers should be permitted to take tax deductions for their intangible drilling costs. This has been permitted under Internal Revenue regulations, but never before written into law. These costs include drilling, labor, overhead, and virtually all other costs exclusive of pipe, machinery and lease equipment. Importance of this change is that it provides a more assured basis on which the industry can plan operations.

2. Loss carryback.

The old rule provided that net operating losses which could not be used in the current year for tax purposes could be carried back one year or forward five years to offset earnings, thus cutting taxes in those years. The new measure keeps the five-year carry-forward but provides a two-year carryback.

Another liberalizing change will allow individuals who sell business assets to include any loss on that sale in their net operating loss carryover for that year. Corporations have been able to do this, but individuals in business have not.

Most important change in the net loss carryover and carryback provision is that oil and gas producers no longer are required for taxable years after 1953 to adjust or carry back the excess of percentage depletion over cost depletion.

3. Depreciation adjustments.

Under the old law it was usually necessary to depreciate under the so-called straight line method, under which the capital investment is recovered evenly over the expected useful life of the property. The new law will make it possible to compute depreciation under any of various "reasonable" methods. One of these is the declining-balance method, which gives the greatest depreciation allowance in the first year and a gradually smaller amount in each subsequent year. As a result, at the end of the estimated useful life of the asset there remains an undepreciated balance representing salvage value. Another method is the sum-of-the-digits, similar in effect to the declining-balance method except that it results in complete depreciation of an asset at the end of its useful life. It is also permissible to change from one method to the other during the useful life of the asset.

4. Aggregation of mineral interests.

The term "property" for the purpose of

The Magic Touch of Electric Power

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Yes, the Magic Touch of Electric Power is very Economical, Efficient and Dependable at this Mainline Crude Oil Pumping Station, operated by a large pipeline company in West Texas. In this station are three 3,000 H.P. and one 1,250 H.P. motors with over eighty Electrically operated valves. You can readily see that Low Cost Purchased Electric Power is doing a real job with its "Magic Touch." For the BEST ALL-AROUND POWER PERFORMANCE . . . SWITCH to Low Cost Purchased Electric Power . . . TODAY! For full details call your nearest Electric Power Company.

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FOR PIPE LINE PUMPS

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Flexibox

MECHANICAL SEALS

SEALOL — exclusive representative in the United States and Canada for Flexibox — offers the pipe line industry a complete and tested line of mechanical seals for pipe line pumps. Flexibox Seals come to this country with over 15 years of actual oil refinery and pipe line service behind them. They afford safety and security never before obtainable with conventional stuffing boxes.

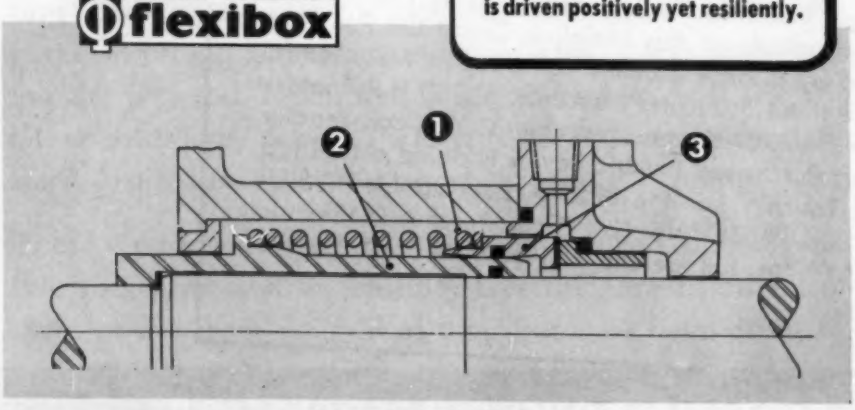
Flexibox Seals are simple and rugged — their unique spring drive reduces mechanical components to a minimum. There are no rubber sleeves or bellows — no keys, pins, slots or grooves. With the Flexibox Type RR seals (shown below) sleeves are furnished as a component of the seal assembly. No pump sleeve required. Designed especially for each installation — no measurements are required for assembly. Seals are supplied with a novel circulating arrangement which assures liquid at the seal faces at all times, removing frictional heat and reducing wear.

Many major oil refining and pipe line companies throughout England, on the Continent, and in South and Central America have standardized on Flexibox mechanical seals for their pumps. Write for Bulletin 9. Sealol Corporation, 23 Willard Avenue, Providence 5, Rhode Island. Chicago • Cleveland • Houston • Los Angeles • Philadelphia • Kansas City • Charleston (W. Va.) • San Francisco • New York • Montreal, Canada. Flexibox, Ltd., Manchester, England.

OPERATING PRINCIPLE OF FLEXIBOX SEALS

The spring ❶ engages the shaft sleeve ❷ at one end and the neck of the rotary seal ring ❸ at the other with interference fits. In operation the coils tend to "wind up", thus further increasing their grip. Consequently, the rotary seal ring ❸ is driven positively yet resiliently.

flexibox



SEALOL

THE BALANCED PRESSURE SEAL

computing depletion allowances is now defined. The general rule stated in the old law is that, for the purpose of computing the depletion allowance in the case of wells, the term "property" means each separate interest owned by the taxpayer in each mineral deposit in each separate tract or parcel of land.

The new code permits a taxpayer to elect to aggregate and to treat as one property, for purposes of percentage depletion, cost depletion, and gain or loss upon a sale or exchange, two or more separate *operating* mineral interests which constitute part or all of one operating unit. This applies to working, not bookkeeping, units, and they need not be contiguous. Aggregated interests lose their separate identities, and all other interests *must* be treated as separate properties.

Other important changes were made in regard to:

• Exploration expenditures (other than for drilling of oil and gas wells). The old rule is that a taxpayer may deduct in the current taxable year up to $75,000 of exploration expenses, or may elect to defer these expenses and deduct them proportionately as the minerals are sold. The measure raises the dollar limit to $100,000.

• Research expenses. These may now be deducted in the tax year in which they are incurred. It was previously possible to make such deductions only for research carried out under a permanent program, thus penalizing the smaller companies. The new rules will not apply to exploration expenditures.

• Dividends. The measure eases the burden of double taxation of corporate dividends by providing that taxpayers will be allowed to exclude $50 a year of dividend income received in any taxable year ending after July 31, 1954. The taxpayer will also deduct from the final tax a credit of 4 percent of any dividends, over and above the $50 exclusion, received after August 1, 1954. However, the credit cannot be more than 2 percent of total taxable income in 1954 and 4 percent of taxable income in later years.

• Organization expenses. Corporations will be permitted to write off their organization expenses over a period of five or more years. Presently, these expenses usually can't be deducted until the corporation finally liquidates.

OGD Pleading for WOC's

Interior Department's Oil and Gas Division, which was reactivated last May after a three-year interlude, is having trouble finding top calibre executives to complete its planned staff. The agency presently has six technical experts on a salary basis plus one official loaned from the oil industry for a short time and serv-

Pipeline Handyman

Versatile Allis-Chalmers HD-5G Pads Rocky Trench, Moves Light Equipment, Handles Supplies— Saves Time and Money on Dozens of Jobs

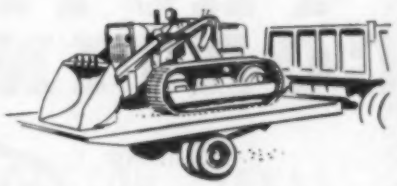
Loads trench padding into trucks — dumping height of 9 ft, ½ in.

At work by the thousands in industry after industry, the Allis-Chalmers HD-5G 1-yd Tractor Shovel can be a real money saver for you on your pipeline spreads. With excellent balance and accurate control, this close quarters specialist quickly loads trench padding into trucks. For those jobs where suitable fill is nearby, the HD-5G digs, hauls and dumps the padding into trench — saves dollars by saving hours of hand labor.

Dumps padding into trench, quickly returns for another load.

Quick-Change Attachments Add to HD-5G Versatility

Bulldozer, angledozer, narrow bucket, rock bucket, crane hook, light materials bucket, trench hoe, lift fork, tine fork, rock fork are quickly interchangeable with standard bucket. Rear-mounted hydraulic ripper or winch adds to HD-5G's versatility. With these attachments it can handle skids, drums, valves — speed dozens of jobs in supply yard, around pump house or on the line.



For job-to-job moves, the HD-5G is easily transported by truck or trailer — only 6 ft, 6¾ in. wide.

Allis-Chalmers Tractor Shovels are available in four sizes — 1, 2, 3, and 4-cubic yards. Your Allis-Chalmers dealer is eager to *prove* the outstanding versatility of this machine — with a demonstration *right on the line!* Set a date now or write for new descriptive literature.

- 50 belt hp
- 16,200 lb including bucket

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NON-DRYING TYPE — A wide range in consistency, from very thin to very thick. All afford excellent rust protection to steel surfaces, yet may be easily removed with any ordinary petroleum solvent.

HARD-DRYING TYPE — These coatings, when dry, form a thin hard uniform film over the surface. They are more than ordinary "paint" because they inhibit or prevent the growth of corrosion under the coating film.

Humble Protective Coatings include not only the well-known RUST-BANS but other special coatings which furnish protection for all kinds of surfaces under all kinds of uses.

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ing without compensation in the agency's top staff positions.

In addition to the division's director, Hugh A. Stewart, the existing salaried staff includes an assistant director for oil and gas operations and four section heads: domestic production, foreign production, gas transmission and distribution, and domestic programming. The refinery specialist on loan is scheduled to return to private industry shortly.

Seven executives are needed urgently by the Oil and Gas Division, of which four probably will have to be officials loaned to the agency from oil companies and to serve without government compensation. These "WOC's," as they are labeled, are needed to fill the posts of assistant director to handle over-all programming, an expert on foreign storage and transportation, a general coordinator for the refinery branch of the agency, and a foreign programming specialist.

Oil and Gas Division hopes to find executives to be placed on a federal salary to serve as head of the remaining unfilled posts: domestic storage and transportation, special refinery products, and rapid tax amortization, liquefied petroleum gas and natural gasoline.

Delay of the Oil and Gas Division in filling its projected top staff with salaried personnel results from the agency's inability to offer salaries commensurate with those received in industry.

Like PAD during its latter stages of operations, OGD has learned that once the urgency for defense planning has receded, individuals in industry are reluctant to take prolonged leaves of absences from their permanent jobs to serve in Washington. Hundreds of key men were furnished by the oil and gas industries to serve in PAW and later in PAD for terms lasting from a few months to one or more years. To be of real value, a WOC executive is needed in Washington for at least a year and oil companies are unwilling to part with key officials for that length of time.

Oil and Gas Division has been a part of the Interior Department since 1946. It was established after the wartime PAW was abolished as a peacetime agency to aid the government (including military services) and the petroleum and natural gas industries to be prepared for future emergencies as far in advance as possible. Purpose of such planning would be to avoid the serious problems thrust upon government and industry at the start of World War II due to lack of a coordinated emergency program for getting essential petroleum produced, refined into necessary products and transported to areas of utility. The agency is a coordinator between various branches of the federal government, the oil and gas producing states and oil and gas companies.

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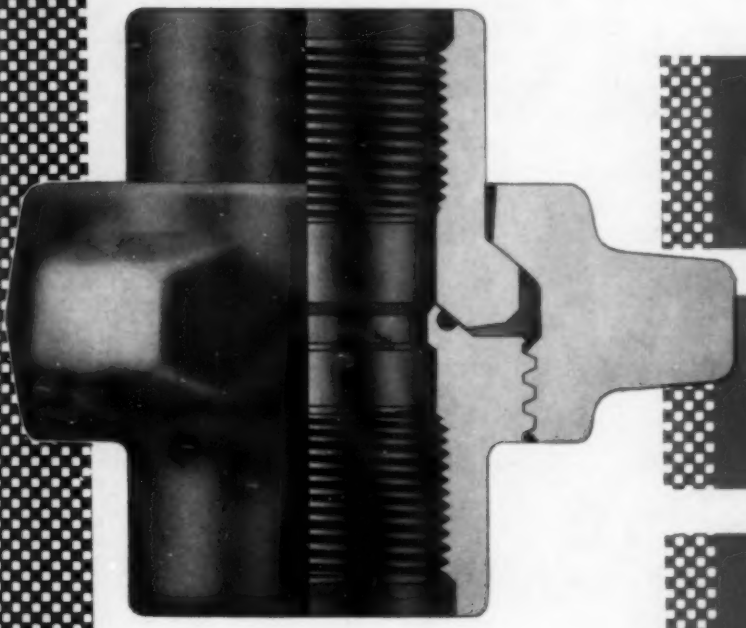

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HOT DOPE

Straight from the Kettle on *PIPE PROTECTION*

★

By Boyd Mayes

We had a character back up home in East Texas who had a fancy for raisin' peas on his little strip of sandy land. One day, while we were walkin' a gun and chasin' a squirrel, we ran slap-dab into the old codger workin' on his fence and cussin' something terrible. "Looks like," we said to him, "here's where some of your cows got out." With much disgust, he answered, "No, here's where some of *his* cows got in. I fence *agin him!*" Somehow, we could never forget the old man's philosophy, his attitude and the job he was working so hard at. It reminds us of our own job . . . fencing "*agin*" corrosion, the number one problem of pipelining. While the best engineering research known to modern science has yet to lick the corrosion problem, they're making some real strides toward it. Meantime, we keep fencing *agin* it by *putting permanence in pipe* through 26 years of know-how in cleaning, priming, coating and wrapping line pipe before it goes into the ground. We've prepared enough pipe for trouble-free service to reach . . . end to end . . . nearly three times around the world. And that includes sizes ranging from ½" to 72". Our skilled craftsmen and up-to-the-minute equipment are ready for your next job of fencing *agin* corrosion.

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Pipe Line Men

IN THE NEWS

Joe T. Dickerson

T. E. Swigart

T. E. Swigart, president of **Shell Pipe Line Corporation,** will retire October 1 after 30 years' service with Shell. He will be succeeded by **Joe T. Dickerson,** who has been the company's vice president in charge of the Midland exploration and production area for the past three years.

Swigart was graduated from Stanford University in 1917 and received his master's degree in engineering in 1918. He spent five years with the U. S. Bureau of Mines as a petroleum engineer and seven months as consulting engineer with Attock Oil Company Ltd.

In 1924 he joined Shell and was made chief production engineer for the company in California. He then became assistant general field superintendent in California; vice president of Shell Oil in charge of exploration, production, crude purchasing, and allied operations in the Southwest; and finally president of Shell Pipe Line. After his retirement, he will open an office as petroleum consultant in Houston.

Dickerson, a graduate of the University of Oklahoma Law School, joined Shell in 1927 and held senior positions in the Legal department of the company in Tulsa, St. Louis, and

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THEY OFFER THESE OUTSTANDING PLUS FEATURES

DURABILITY—All parts of the new Rochester straight-form thermometers (except crystal) are of corrosion-resistant stainless steel. All are fused into a single unit by an exclusive welding process. Hermetic sealing assures easy reading of dial under any operating condition. No clouding.

EXTERNAL RECALIBRATION—Only Rochester thermometers can be recalibrated externally. A screw adjustment permits you to restore accuracy even if you knock the thermometer out of adjustment with a hard blow.

SELECT YOUR STEM POSITION—This thermometer is ordinarily supplied with the stem located at the bottom. However, it can be placed at the location you desire around the entire dial circumference. Available in stem lengths from 2½ to 48 in. Send for further information today. Write:

Rochester Manufacturing Company, Inc.
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How GM DIESEL POWER helped lay

WORLD'S LONGEST PIPE LINE

30-inch Lakehead Pipe Line moves through upper Michigan swamplands, where welders needed platforms to keep from sinking in muck. On this 100-mile section, Midwestern Constructors used a battery of Lincoln portable welding machines each powered by a two-cylinder GM Diesel engine.

Crossing the Straits—GM Diesel-powered tugs keep Merritt-Chapman's cable-laying barge on course by running guide lines to buoys for one of the longest and deepest underwater crossings in pipe line history.

Shooting a "pig"—Tight-fitting disc, called a "pig," is shot through welded pipe to remove dirt. Air blast is delivered at steady pressure of 100 psi and better by GM Diesel-powered Ingersoll-Rand compressor supplying up to 600 cubic feet of air per minute.

Digging rock—Where going was rough, GM Diesel-powered Unit backhoes dug trench. Midwestern used these fast-moving shovels to follow blasters along route. Interchangeability of standardized GM Diesel parts in all equipment simplifies inventory, cuts costs.

Lining up pipe—GM Diesel-powered Allis-Chalmers tractors line up 2500-ft. welded pipe sections. They also moved pipe and welding machines and handled many utility jobs. Work gets done faster with smoother-running GM 2-cycle Diesels in your equipment line-up.

CONTRACTORS, with an early winter deadline to beat, depended upon a variety of General Motors Diesel-powered equipment to lay the Lakehead Pipe Line Extension through Michigan and across the Straits of Mackinac in record time.

Wherever you have close schedules to meet—or competitive bids to beat—you'll be money ahead with GM Diesel power, because this versatile 2-cycle Diesel gets work done faster at lower cost. Let this great GM Diesel engine prove its superior economy and dependability on *your* job!

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. . . available in more than 750 models of equipment built by over 150 manufacturers

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Houston. He was general attorney in the Houston office in 1942 when he left for three years' service with the Army Air Corps.

He returned in 1945 as assistant secretary of the company and manager of the head office Legal department in New York. From 1947 to 1951 he was manager of the Houston exploration and production area. His next assignment was to Midland.

J. E. Clark, production manager of Shell's Denver area, will replace Dickerson in charge of the Midland area. Clark is an engineering graduate of Stanford University.

C. S. (Charlie) Coates, formerly senior vice president of **Tennessee Gas Transmission Company,** has been elected executive vice president and general manager of **Trans-Canada Pipe Lines, Ltd.,** of Calgary.

C. S. Coates

He will have direct charge of construction and operation of Trans-Canada's $297 million natural gas pipe line to be built next year from western to eastern Canada.

Coates has been with Tennessee Gas since 1943. He helped build the company's original line from South Texas to West Virginia. Since joining Trans-Canada, he has moved from Houston to Calgary, where he and his family will make their home.

•

New president of **Yellowstone Pipe Line Company** is **George A. Wilson,** who is also president of **Interstate Oil Pipe Line Company.** Yellowstone was organized last year to build a 540-mile products line from Billings, Mont., to Spokane, Wash.

Other officers elected by the Yellowstone board of directors are **W. L. Kygar,** vice president and general manager, and **John D. Morrow,** secretary. Both are with Continental Pipe Line Company. **R. L. Bosworth** of Continental Oil Company was named treasurer, and **P. H. Hunter,** Interstate Oil Pipe Line, assistant secretary-treasurer.

Directors of the organization are **Wilson; Kygar; Joseph L. Seger** and **Thomas Brownfield,** both of Carter Oil Company; **W. Turner Clack** of **H. Earl Clack Company; E. L. Hiatt** of Union Oil Company of California; and **J. W. Liddell** and **T. A. van Griethuysen,** both of Continental Oil.

•

S. V. (Sammy) Collins, owner of Collins Construction Company, has announced the formation of a new Venezuelan corporation, to be known as Construcciones Collins De Venezuela C. A. The new company will handle the construction, laying and trenching of submarine pipe lines in Venezuela, South America and other parts of the world.

The officers are S. V. Collins, president; French T. Glasscock, vice president; Jean E. Johnson, vice president; Rowland J. Burton, treasurer; Edward D. LeBoeuf, resident general manager; and William F. Coles, secretary and general counsel.

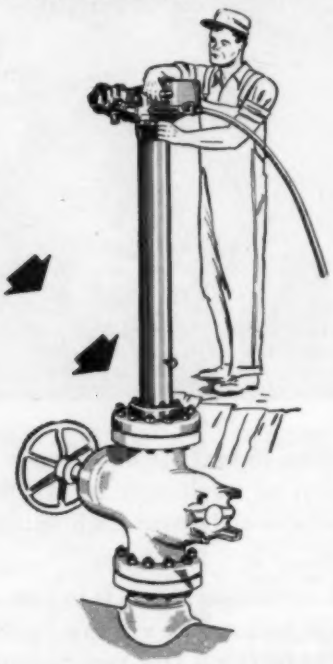
The Collins organization will begin its first project, the trenching of two 20-inch submarine pipe lines across Lake Maracaibo for Shell de Venezuela. Work will commence August 15. Collins recently completed the world's longest sea-loading line off the Gold Coast of Africa for Socony-Vacuum; and is now laying 84,000 feet of submarine line for the Bombay Port Trust near Bombay, India.

Announcing the **NEW . . .**

ASA 600# RING JOINT FLANGE PERMITS **PRESSURES TO 1,440 P.S.I. @ 100° F. TEMPERATURES TO 700° F. @ 700 P.S.I.**

WmSON-HILL CO MODEL 660 TAPPING MACHINE*

FOR MAKING CONNECTIONS TO PIPELINES AND TANKS WITHOUT SHUTDOWN OR DRAINAGE



★ 42" TRAVEL LENGTH OF BORING BAR *permits* . . .
PIPE TAPS TO 14" SIZE
TANK TAPS TO 16" SIZE

★ CHOICE OF POWER compact air motor or complete hydraulic drive (including engine driven pump) provides dependable lower cost power.

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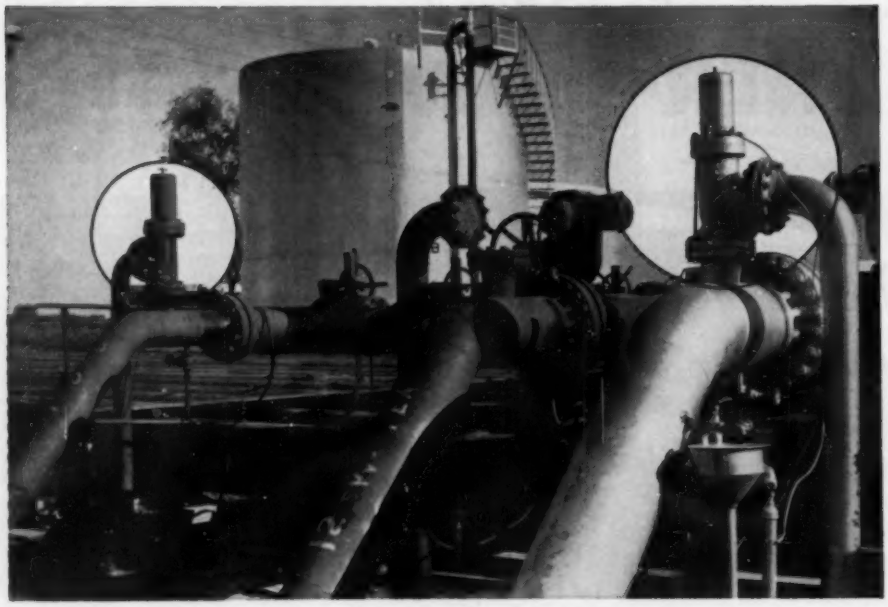
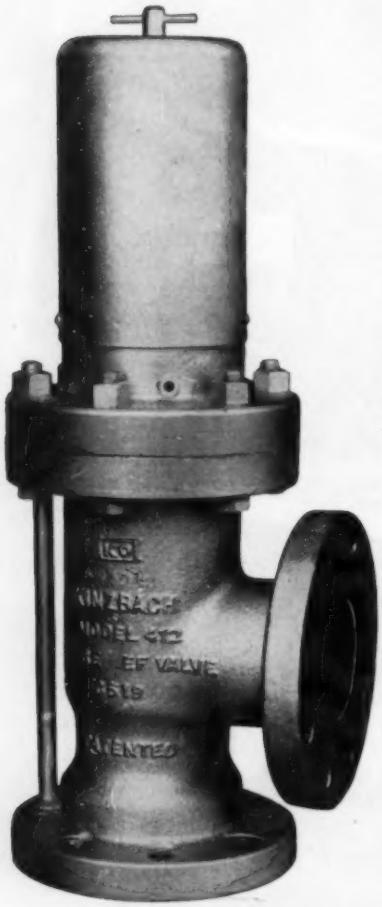


Positive Protection Against Pressure Surges



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RELIEF VALVE
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When a pressure overload in the line is reached, the Kinzbach Model 412 Relief Valve opens instantly to full capacity. This valve provides automatic resetting at a pre-determined pressure drop, positive seating and facilities for functional testing.

The Model 412 uses line pressure for opening and closing. The opening pressure is preset by application of a dead weight load. Opening and closing action is positive and reliable. The pre-set pressure never changes.

Kinzbach Model 412 Relief Valves are available in 2", 3", 4", 6" and 8" sizes for working pressures up to 1000 p.s.i. Write for Bulletin RV412 for full technical data.

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C. L. Morgan

C. L. Morgan is new operating superintendent for the Texas distribution division of **United Gas Corporation. E. M. Cannon** will succeed him as Houston division manager, and **Leroy G. Malloch** will follow Cannon as East Texas division manager.

•

Other changes within United Gas include the promotion of **D. D. Dillingham** to superintendent of operations for United Gas Pipe Line Company; **Paul Williams** to chief engineer of United Gas Pipe Line and Union Producing Company; **J. D. Davis** to superintendent of the Western pipe line division; and **R. M. Hearin,** district manager at Jackson, Miss. **W. W. Clopton,** San Antonio district manager, has retired after 30 years of service, and will be succeeded by **W. O. Allen.**

•

President of **Arapahoe Pipe Line Company,** the new Sinclair-Pure crude carrier from the Denver-Julesburg Basin to Humboldt, Kansas, is **Earl W. Unruh** of Sinclair Pipe Line Company.

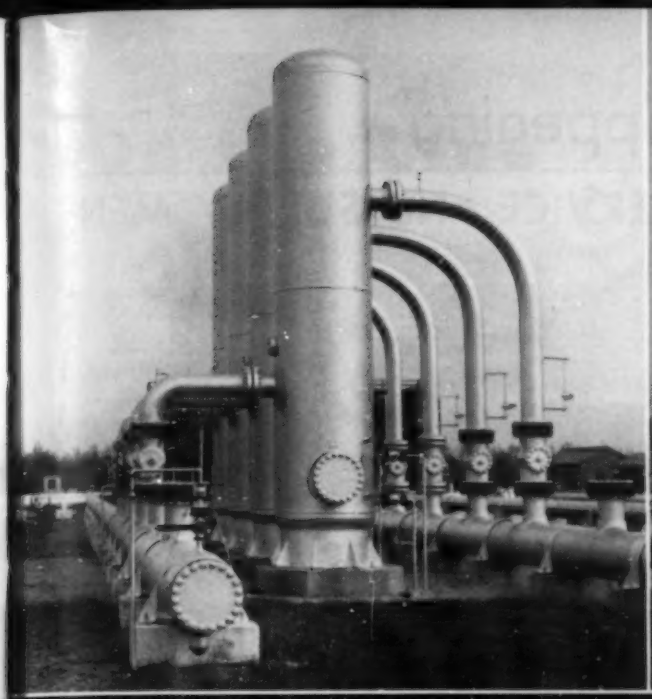
Other officers are **C. E. Dickey** and **Joseph W. Meehan,** both vice presidents and directors; and **J. D. McConnell, Victor H. Bowman,** and **Allen C. Hutcheson,** directors.

•

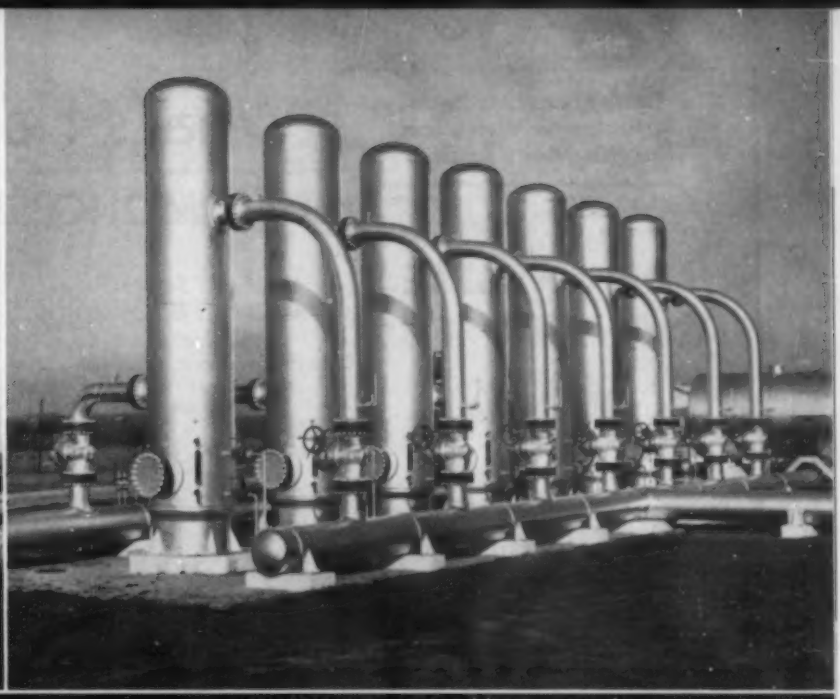
W. K. Smith, a veteran of 35 years of pipelining for **The Ohio Oil Company,** has been appointed assistant division superintendent of the company's Martinsville division. Smith was formerly superintendent in charge of construction and maintenance in Martinsville.

•

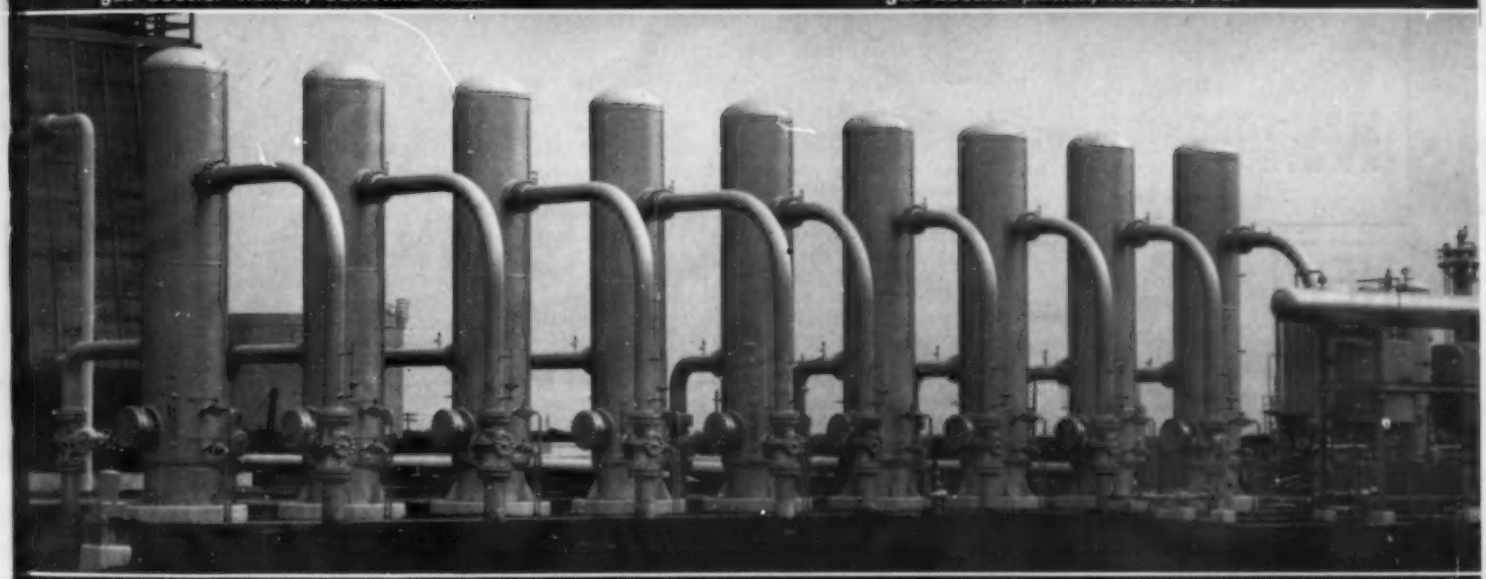
C. A. Chipman has been reelected president of the **Pennsylvania Grade Crude Oil Association.** Other officers reelected are **George J. Hanks,** first vice president; **A. C. Simmons,** second vice president; **Fayette B. Dow,** vice president and general counsel; **Samuel Messer,** treasurer; **F. W. Alcorn, C. L. Suhr,** and **C. G. Johnson,** assistant treasurers; and **W. C. Wenzel,** executive manager. Elected as honorary director was **E. M. Craig,** who retired as an active director.



NATIONAL Gas Scrubbers, main line gas booster station, Batesville Miss.



NATIONAL Gas Scrubbers, main line gas booster station, Monroe, La.



NATIONAL Gas Scrubbers, main line gas booster station, Banquitte, Texas

NATIONAL WET-TYPE SCRUBBERS

54" O.D. x 20' — 750 PSI MAX. WP.
90 MM CU. FT./DAY. 12" INLETS AND OUTLETS

The service required of Wet-Type Scrubbers! Pipe line dust and other foreign materials are removed ahead of compressors at each pressure boosting station. This is done best by passing the gas through a special oil bath in a National Wet-Type Scrubber, then removing the liquid particles from the gas stream when passing through the National Gas Scrubbing element in the top part of the Scrubber.

National Vertical and Horizontal Gas Scrubbers are available in a wide range of sizes, working pressures and capacities to fit the needs of gas producers and carriers.

It's a National®

NATIONAL TANK COMPANY

TULSA, OKLAHOMA

2-5-54

See Composite and Refinery Catalogs, or Write for Specifications Folder

FLEET-LINE

PIPE SADDLES AND REDUCERS

Nozzle sizes from ¼" to 24"

ASTM A234

Also for pressure vessel heads

Nominal pipe sizes 1" to 30"

Special sizes and lengths. Schedules 10 to 160

ASA B16.9
ASTM A234

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STEEL FORGINGS, Inc.

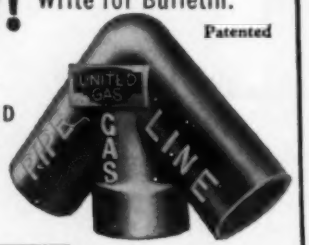
P. O. Box 276K • Shreveport, La.

Foot of Fannin Street

NEW! Write for Bulletin.

Patented

PIPELINE VENTS AND MARKERS



FLEET-LINE CO.

P. O. BOX 276K

SHREVEPORT, LOUISIANA

GUNITE COATINGS for PIPE LINES

Reinforced GUNITE COATING being applied to pipe.

Your inquiry solicited.

GUNITE CONCRETE & CONST. CO.

1301 WOODSWETHER RD., KANSAS CITY, MO.
2036 ADDISON, HOUSTON, TEXAS
CHICAGO — ST. LOUIS — DENVER
MINNEAPOLIS — NEW ORLEANS

What's Happening

AMONG SERVICE AND SUPPLY MEN

U.S. Steel Begins Production Of Larger Dimension Pipe

A new dimension has been added to long-distance overland transportation of gas and oil with U. S. Steel's production of 36-diameter pipe at its Orange, Texas, plant.

The company's Consolidated Western Steel division started the first mass tonnage production of the new dimension pipe for long-distance use in August.

A significant step-up in carrying capacity over 30-inch pipe is afforded by the 36-inch pipe. Thirty-inch is the maximum size generally in use; only one gas transmission system formerly used pipe larger than 30-inch, and this was 34-inch.

Besides transporting a greater volume of gas and oil, the larger pipe will be of increased value for the storage of petroleum products in areas adjacent to markets.

Joy Manufacturing Appoints Executive Vice President

Joy Manufacturing Company announces the election of John Lawrence as executive vice president. Lawrence, in addition to assuming the responsibilities normally associated with his new post, will give special attention to Joy efforts toward further diversification of the company's product lines.

Lawrence joined the company in July 1951 as vice president—manufacturing—and in April 1953 was named vice president—manufacturing and engineering. His prior experience includes seven years with SKF Industries Inc., where he served as vice president, and 10 years with Jones and Lamson Machine Company, where he was factory manager.

Littlefield Becomes Manager For Air Reduction Sales

W. W. Littlefield, assistant sales manager of the Oklahoma district, Air Reduction Sales Company, became district manager of the El Paso, Texas, district succeeding H. F. Colt, Jr., who was appointed eastern zone manager of the Railroad department. Littlefield has been with Air Reduction since 1946 during which time he held various positions including district office manager in the Oklahoma district.

W. M. Champion, salesman in the Oklahoma office, succeeded Littlefield as assistant sales manager of that district.

Graver Announces Appointment Of Fosnot as Sales Manager

Graver Water Conditioning Company, division of Graver Tank & Manufacturing Company, Inc., New York, has announced the appointment of Harold R. Fosnot as sales manager.

Fosnot joined Graver upon graduation from Purdue University in 1935 and became a member of Graver's first training program. He was previously Chicago district manager, Eastern sales manager and most recently assistant general sales manager.

R. C. Gamble

Marvin Wall

Nordberg Manufacturing Promotes Wall and Gamble

Appointment of Marvin Wall as district manager of the Heavy Machinery division and R. C. (Dick) Gamble as sales engineer, Dallas territory, of Nordberg Manufacturing Company has been announced.

Wall is promoted to the district managership succeeding C. B. Trimble, recently retired. He assumes the responsibility for serving Nordberg customers and prospective users in Oklahoma, New Mexico, and North and Central Texas.

Wall, a veteran of almost 20 years in the Diesel engine business, started his career with the Cooper-Bessemer Corporation in 1935 where he progressed from the Parts department to manager of that department, and to sales engineer in the southwestern states. In 1949 Wall joined Nordberg to serve as sales engineer in the Dallas territory until his recent appointment.

Gamble was formerly with Cleaver-Brooks Company and in 1948 joined the Nordberg organization. He was initially assigned to Nordberg's Export Sales department; in 1952 was promoted to sales and service engineer. Gamble will assist in field engineering and the sale of Nordberg's extensive line of heavy duty engines ranging up to 10,800 horsepower.

Coating Engineering Firm Opens Houston Headquarters

Protective Coating Engineering and Inspection Service announces the opening of new headquarters in Houston. Warren D. Palmer, who heads the new service firm, worked as field engineer on construction for The Austin Company, and Ford Bacon & Davis. For the past 12 years he has been an employe of the Monsanto Chemical Company at the Texas City, Texas, plant. The last six years he worked as inspector and protective coating engineer in the corrosion and engineering section.

The company offers a complete engineering service for protective coatings, including evaluating paints and coatings in actual plant exposure, surveying painting and paint practices, making recommendations and preparing complete painting specifications and painting schedules. In addition the company offers a supervision and inspection service for fabrication and construction of new equipment, structures, marine and plant installations.

On the Line . . for Years to Come

ALLIS-CHALMERS ENGINES will

deliver dependable-economical Power

WHY

The first cost is lower—not one competitive engine with all the features of Allis-Chalmers Engines and comparable in cubic inch displacement is so low in first cost.

and WHAT are THESE FEATURES

Valve in head—removable wet cylinder sleeves, large capacity, high turbulent cooling for stationary work—oil pressure lubrication at any speed—enough metal in block to prevent warping and misalignment of working parts—rated output developed at medium speeds.

AND

When the day for repairs comes along as it surely will on any engine, compare the cost of crank shaft, water pumps, cylinder kits, blocks and other replacement parts with any other engine—You'll be surprised at the low cost.

Allis-Chalmers Engines are heavy and rugged, they're built to give long service on the toughest jobs.

COMPARE

1. Allis-Chalmers Quality
2. Allis-Chalmers First Cost
3. Allis-Chalmers Parts Cost

With those of any other engine

FRED E. Cooper, Inc.

P. O. Box 1890 TULSA, OKLA.

Houston, Odessa, Los Angeles, Olney, Illinois

JET-LUBE
VL-5
VALVE LUBRICANT

WITH MOLY-DISULPHIDE

High temperature, non-melting silica base valve lubricant with low friction moly-disulphide. Use JET-LUBE VL-5 on valves that are hard to turn. Resistant to hydro-carbons, water, acids, sulphur and alkalies. Batch controlled. Fully guaranteed.

Order through your supply store or send for complete details

JET-LUBE INC.

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D. L. Gallogly

T. O. Kuivinen

Cooper-Bessemer Creates New Engineering Divisions

The formation of three primary engineering divisisons at The Cooper-Bessemer Corporation, Mount Vernon, Ohio, has been announced. Now known as the Development division, Technical division, and Product division, the activities of each division will be directed by its own chief engineer.

W. R. Crooks

Cooper-Bessemer's newly created Development division institutes new designs and includes all research and experimentation. The Technical division comprises stress analysis, torsional vibration, and other mathematical computations, metallurgy, fuels, lubricants and technical publications. It serves both other divisions. Engineering-manufacturing liaison and application and service of all Cooper-Bessemer engine and compressor equipment will be handled by the Product division.

W. R. Crooks was promoted to chief engineer, Development division, who became associated with Cooper-Bessemer in 1936.

Dennis L. Gallogly, now chief engineer of the Product division, came to Cooper-Bessemer 25 years ago.

Chief engineer, Technical division is T. O. Kuivinen, who came to Cooper-Bessemer in 1929 where he has held various engineering positions during 25 years of continuous service.

The new Cooper-Bessemer engineering organization plan will be headed by R. L. Boyer, vice president and chief engineer. The programs of the three divisions will be coordinated by E. Frederick, executive engineer.

Bonney Forge & Tool Works Announces Personnel Changes

Organizational changes of personnel in Bonney Forge & Tool Works, Allentown, Penn., have been announced. Bonney Forge & Tool Works is a subsidiary of Miller Manufacturing Company.

Appointed as general manager is Spencer H. Mieras and Kenneth Foust as secretary-treasurer. Both Mieras and Foust are with the Miller organization in Detroit.

Rearrangement of managerial appointees resulted from the recent resignation of Arthur J. Male, chairman of the board; Fred S. Durham, Jr., vice president and secretary, and Edward S. Howells, treasurer.

TEMPORARY STRAINERS

MAC-IRON SANDUSKY OHIO

Established 1901

Made by a skilled mechanic and not by "just some guy with a torch."

REVOLUTIONARY CONSTRUCTION

Smooth, efficient contours . . . no weld "blob" around edge of ring. The flange is precision rabbeted into the ring joint gasket making deformation at that point impossible.

MAC-IRON offers a complete listing of line and temporary strainers. The latter of woven wire, perforated basket and conical . . . all for use with raised face, and ring joint flanges.

A large stock on hand is maintained; special strainers made to specification. Write direct for a catalog and complete information.

The Mack Iron Works Company

Warren and Water Sts. Sandusky, O.

install peak performance into your compressors (AIR • GAS • AMMONIA)

Peak performance, maximum efficiency, greater output, and lower power costs can be built into your oldest, and of course your newest, compressors by the installation of VOSS VALVES.

Check THESE VOSS VALVE ADVANTAGES:

✓ Quiet, vibration-free operation ✓ 20 to 60% more valve area ✓ less power consumption ✓ minimum pressure loss ✓ normal discharge temperature ✓ lower operating costs ✓ utmost safety

Our detailed proposal for increasing the efficiency of your compressor will be sent you without obligation. Send us the name, bore, stroke, and speed of your machine.

VOSS VALVES / J. H. H. VOSS Co., Inc. 784 East 144th Street, New York 54, N. Y.

LIGHTNIN MIXERS in service at this pipe line tank farm keep B. S. & W. in uniform suspension in the crude. They eliminate the need for periodic tank cleanout.

Make your tanks do 12% MORE WORK

CONTROL B. S. & W. to get extra storage capacity . . . *at no extra cost*

If yours is like many tank farms, bottom sludge may be stealing 12% of your tank storage capacity.

You can say good-bye to this costly nuisance—for good—by installing LIGHTNIN Mixers to control B. S. & W. in your tanks.

You can save money four ways by using LIGHTNIN Mixers:

1. You increase tank capacity, because LIGHTNINs prevent bottom sludge buildup.

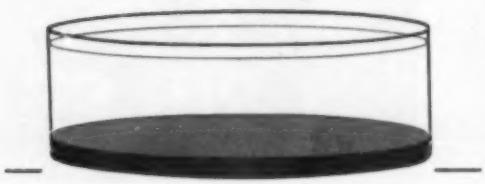
2. You save petroleum values often lost in the sludge (a 2-foot level of sludge in a 120-foot diameter tank may contain 4,000 barrels of merchantable material).

3. You save tank cleanout costs.

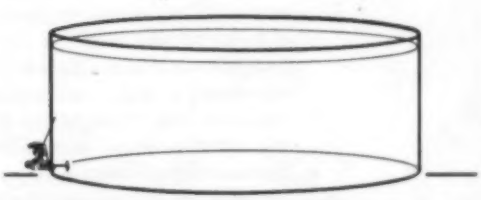
4. You eliminate tank downtime for cleaning.

Because of these savings, LIGHTNIN Mixers have paid for themselves in as little as three weeks! We can show you figures to prove this.

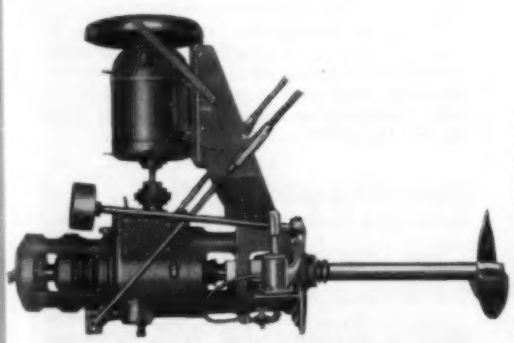
Be sure to get LIGHTNIN Mixers—they're *guaranteed* to do the job right. Full satisfaction—or your money back. This unique guarantee is backed by thousands of successful installations in pipe line company and refinery tank farms. Sold by factory-trained engineers, experienced in serving the oil industry. Specify LIGHTNIN—and be sure.



BEFORE USING LIGHTNIN MIXERS
Diameter—120 ft.
B. S. & W. level—2 ft.
Storage capacity lost—4,000 bbls.



AFTER USING LIGHTNIN MIXERS
Diameter—120 ft.
B. S. & W. level—None
NO **storage capacity loss**



LIGHTNIN SIDE ENTERING MIXERS For tanks up to 6 million gallons capacity. Full range of sizes—1 to 25 HP. Gear drive (shown) or V-belt drive.

MIXCO fluid mixing specialists

Lightnin® Mixers

MIXING EQUIPMENT Co., Inc.

196-j Mt. Read Blvd., Rochester 11, N. Y.

In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Ave., Toronto 10, Ont.

Please send me, without obligation:

☐ B-503—New 4-page illustrated bulletin giving complete information on B. S. & W. control and savings.

☐ B-104—New 20-page illustrated catalog containing full description, specifications and dimensions of LIGHTNIN Side Entering Mixers.

Name_____

Title_____

Company_____

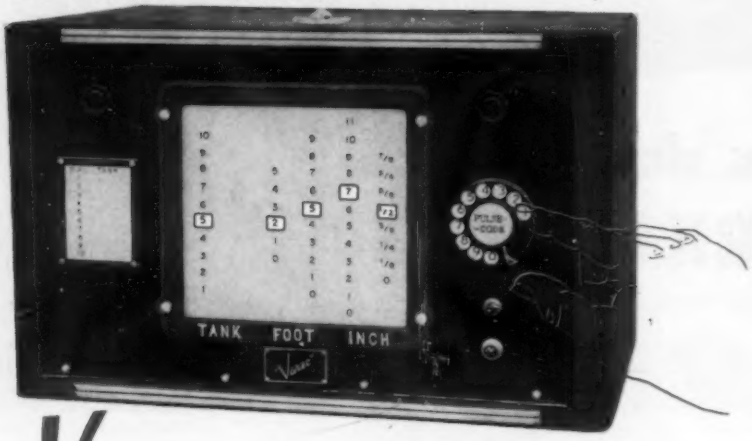
Address_____

City_____ Zone____ State_____

SCALE OF MILES

0 10 20 30 40 50 100

. . . accurate liquid level gauging-
at ANY DISTANCE!



"Varec"

SEE PULSE CODE AT THE INSTRUMENTS SHOW IN PHILADELPHIA, SEPT. 15-21 BOOTHS: 757, 759, 761

PULSE CODE
TELEMETERING SYSTEM
(PATENTS APPLIED FOR)

THE VAPOR RECOVERY SYSTEMS COMPANY has successfully eliminated the one great drawback to accurate transmission of remote tank gauging over long distances — *loss or gain of a part of the signal.*

Through use of the pulse code method of message transmission the system utilizes a separate pre-arranged code for each 1/8" increment of measurement.

At the receiver, the code transmitted by the tank unit is translated into the equivalent measurements — there can be no borderline cases where the reading might fall between two increments. The receiver will either produce the *correct* reading as transmitted *or it will not produce any reading.*

Obviously such an exact system is not confined to liquid level telemetering alone. It can be readily applied to numerous supervisory control problems such as remote control of pump motors, control valves and associated equipment. Thus the complete dispatching operation, gauging and remote control is integrated into one single unitized system when a "Varec" Pulse Code Telemetering System is installed.

The equipment is also capable of providing tank liquid level alarms or warnings of any off-normal conditions at the remote control point. Further, the receiver readings may be fed into automatic printing equipment for a permanent record and automatic sequencing equipment may be added to provide fully automatic tank gauging.

Before you install any type of remote gauging we urge you to thoroughly investigate the "Varec" Pulse Code Telemetering System — write today for complete details.

"Varec"

THE VAPOR RECOVERY SYSTEMS CO.
COMPTON, CALIFORNIA
Cable Address: VAREC COMPTON
Calif. (U.S.A.) All Codes

961-2

Roy Lilley, Jr.

Bob Miller

Lufkin Foundry & Machine To Distribute Gaso Pumps

Gasco Pump & Burner Manufacturing Company, Tulsa, has appointed Lufkin Foundry and Machine Company as distributor for Gaso pumps in the Rocky Mountain area. Lufkin headquarters are at Casper, Wyo., where Bob Miller serves as division manager and Roy Lilley, Jr., is in charge of sales and service.

Sales and service facilities are also maintained at Williston, N. D., and Sterling, Colo., under the direction of Jack Read and G. W. Nichols.

Aerofin Corporation Moves To Larger Plant in Syracuse

To take care of increased heat-exchanger production required by the expansion programs in the petroleum and process industries and by the boom in residential and commercial air conditioning, Aerofin Corporation has moved to a new plant at 101 Greenway Avenue in Syracuse, N. Y. The new plant contains 80,000 square feet of production space on one floor, and occupies a six-acre plot adjacent to the New York Central main line. It is also convenient to the North-South and East-West truck routes.

The entire plant will be devoted exclusively to the manufacture of extended heat-exchange surface which Aerofin pioneered and has manufactured exclusively since 1923.

Corson Appointed to Position With Pittsburgh Coke & Chemical

H. J. Corson has been appointed to the sales staff of the Protective Coatings division, Pittsburgh Coke & Chemical Company. Corson has been assigned to the division's New York office.

He will be primarily engaged in serving architectural and engineering companies in the area with technical data and specification assistance on the utilization of the company's complete line of Pitt Chem tar base maintenance coatings.

Prior to joining Pittsburgh Coke & Chemical Company, Corson was associated with the Columbia Steel & Brass Corporation and prior to that with the Johns Manville Corporation. He is a graduate of New York University.

Caterpillar Tractor Transfers Osterhout to Industrial Sales

Ross Osterhout has been transferred to the Industrial Sales division of Caterpillar Tractor Company.

Osterhout, formerly an engine representative for portions of Texas, is being transferred in order that better use can be made of his experience in the pipe line

pumping field. A native of Texas, he has been connected with oil field work all of his life.

Replacing Osterhout as engine representative is Jack Gilbert. He and his family will reside in Fort Worth, Texas, with his primary area of assignment including territories covered by Central Texas Machinery Company, Darr Equipment Company, Holt Equipment Company, Wm. K. Holt Machinery Company, and Mustang Tractor & Equipment Company.

Quiggin Receives Position With Read Standard Corporation

The Read Standard Corporation has recently expanded its sales engineering facilities with the appointment of Frank W. Quiggin, as assistant to vice president-sales, to its Blower-Stoker division sales headquarters in New York. Prior to his new appointment, Quiggin was a mechanical engineer with The Cooper-Bessemer Corporation, Mt. Vernon, Ohio, where he was associated with application engineering related to diesel engines, gas engine and motor-driven compressors.

Frank W. Quiggin

Quiggin is an engineering graduate of The North Gloucestershire Technical College in England. During World War II he served six years as a Technical Officer in the Engineering Branch of the Royal Air Force Volunteer Reserve. Following his military service and prior to his coming to America in 1948, he spent a year as chief test administrator of the De Havilland Propeller Co., Hatfield, England.

Quiggin's efforts will be under the direction of Charles J. Surdy, vice president-sales, and will be directed toward the application of the petroleum processes, allied refining and industrial applications in which Standardaire blowers, gas booster compressors, vacuum and vapor pump equipment is widely used.

Steel Pipe for Alaskan Line Makes 9500-Mile Trip by Water

Seamless steel pipe from the Aliquippa, Penn., Crane Works of Jones & Laughlin Steel Corporation, destined for the new 621-mile Haines-Fairbanks pipe line in Alaska, is making the 9500-mile trip entirely by water.

J & L is supplying 8300 tons of pipe for the job. It is being shipped about 2000 miles by barge down the Ohio and Mississippi Rivers to New Orleans. Each barge carries about 500 tons of pipe, the equivalent of 12 railroad carloads.

At New Orleans the pipe is transferred to a freighter for the 7500-mile leg of the journey down through the Panama Canal, and up the West Coast to Haines, south of Skagway on the Alaska coast.

The entire trip from Aliquippa, which is on the Ohio River about 20 miles below Pittsburgh, will take about eight weeks. The $30,000,000 pipe line is being built by the U. S. Army to carry aviation, motor, jet and diesel fuels to military bases in the interior of Alaska.

J & L seamless pipe going into the line is 8⅝ inches in diameter and weighs about 25 pounds per lineal foot.

offer constant and dependable service year in and year out

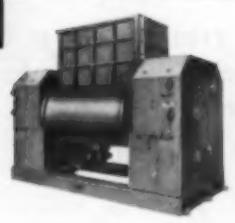
The *Standardaire* Blower is designed and service tested for high speed operation. The *Standardaire* employs a proved principle of compressing air on a modified adiabatic cycle with lower mean internal pressure. This permits the *Standardaire* to discharge the greatest output per pound of weight ever achieved in this type blower. *Standardaire's* symmetrical, cycloidal rotors act as an air screw. The air is taken in and discharged smoothly from pockets which form between the rotors. The compression is gradual and free from shock resulting in a lower decibel rating than for comparable units of other positive displacement types.

Get further information on the *Standardaire's* application to the petroleum industry. Write today:

READ STANDARD
CORPORATION

BLOWER-STOKER DIVISION
370 Lexington Avenue
New York 17, New York

Read Standard also manufactures a complete line of chemical mixers for laboratory and industrial use. For information write, Read Standard Corp., York, Pa.



For more data on advertised products, use Readers' Service Cards, last page.

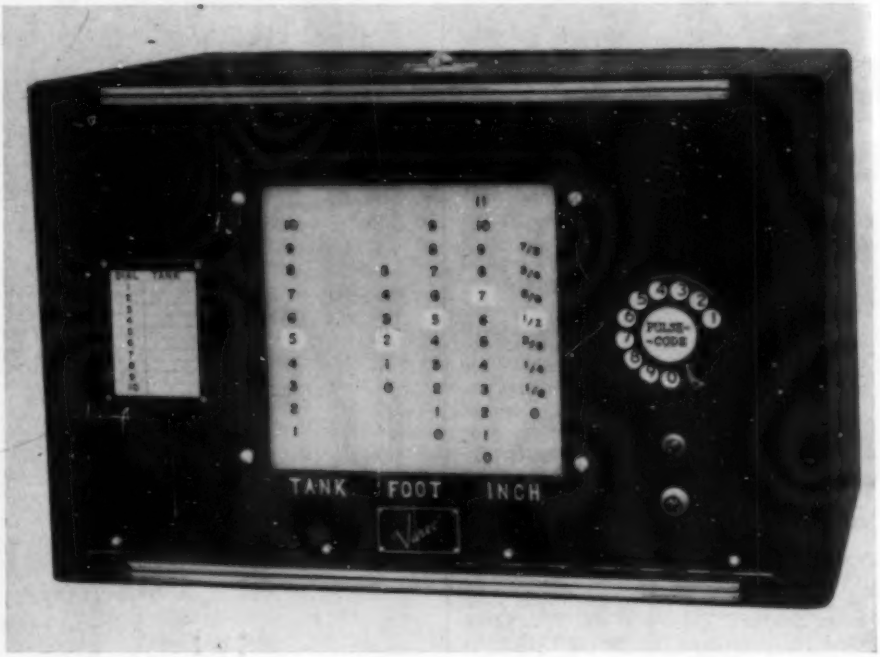
What's New in Equipment

for the Pipe Line Industry

Telemetering System

The Vapor Recovery System Company is announcing its new "Varec" pulse code telemetering system. This pulse code system utilizes a prearranged code for each increment of intelligence to be transmitted. The transmitter portion of the system sets up the code for the particular value of liquid level, or other information, and transmits this to the receiver portion of the system. At the receiver, the incoming code is translated into the equivalent measurement increment. Each code is a distinct value, there are no borderline cases where the value may fall between two increments.

The "Varec" equipment is capable of providing liquid level alarms or warnings of other off normal conditions at the remote control point. To further complete the adaption to remote control and to provide a step toward completely automatic operation, the pulse code receiver output can be fed into printing equipment to provide a permanent record of the gauge readings, alarm warnings and other functions. Along with automatic printing equipment, automatic sequencing equipment can be added to provide fully automatic gauging.



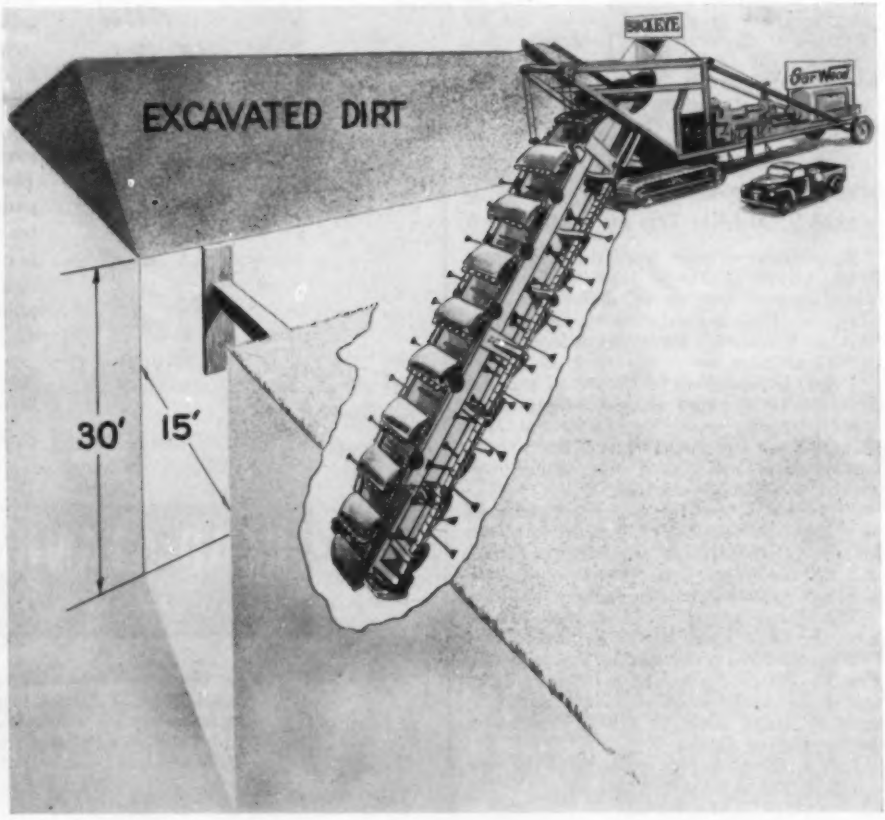
For more data, circle **No. E1** on Readers' Service Card, last page this issue.

Mammoth Ditcher

The largest ditching machine in the world, capable of digging a ditch 15 feet wide and 30 feet deep, is now being designed, according to an announcement by Gar Wood Industries.

Over-all dimensions of the new ditcher are, length, 81 feet; height, 15 feet; width, 12 feet. Its estimated weight will be 65 tons. The machine will be crawler mounted at the digging end and supported by rubber-tired front wheels. Power will be supplied by two diesel engines with torque converters. Another feature is the use of hydraulic power steering.

For more data, circle **No. E2** on Readers' Service Card, last page this issue.

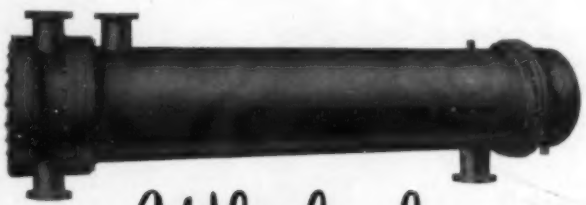


Save time! Keep informed! Circle numbers on Readers' Service Cards, last page this issue.

PROTECT YOUR COMPRESSORS FROM WASTE HEAT

The efficient operation of your compressors — in fact, their *life* — depends on the removal of waste heat from lubricating oil and water cooling systems. The Whitlock Type SG Cooler is specially designed for such service. It is small yet capable of handling relatively high heat loads, and its standardized design means low cost and prompt shipment.

The cooler is two-pass in design and properly baffled to develop high fluid velocities and subsequent high heat transfer rates, with minimum pressure drop. Its non-ferrous tube bundle, cast iron channel and steel pipe shell mean long, trouble-free equipment life even under severe operating conditions. Bulletin 122 gives you the whole story on Whitlock Lube Oil and Jacket Water Coolers. For your copy, just fill in and return the coupon today.



Whitlock

WHITLOCK Designs and builds: bends, coils, condensers, coolers, heat exchangers, heaters, piping, pressure vessels, receivers, reboilers.

THE WHITLOCK MANUFACTURING CO.
98 South Street, Hartford 10, Conn.

☐ Please send Bulletin 122 describing Whitlock Lube Oil and Jacket Water Cooler — Type SG.

Name .....

Title .....

Company .....

Address .....

NEW CATALOG D

. . . contains complete descriptions, specifications and illustrations of Tracerlab's nuclear instrument, radiochemical and laboratory accessory line . . . the largest and most comprehensive of any manufacturer in the nucleonic field. Included are the new Autoscaler, available in seven models; the Automatic Flow Counter; a newly redesigned Laboratory Monitor; several new Geiger-Mueller tubes, including the TGC-20 Well Geiger Counter; new sources; as well as many new chemicals and accessories. A unique section of this catalog describes such custom equipment as the Liquid Scintillation Detector, MEW Counter, Multichannel Analyzer, Argon Gammagraph, Robot Scaling Equipment with Robot Sample Changer, Facta Printer and Automatic Chromatogram Scanner, a Beta Ray Spectrometer, Four Pi Counter and special air monitors. If you haven't received a copy, please request one.

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2030 WRIGHT AVE., RICHMOND, CAL.

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For more data on advertised products, use Readers' Service Cards, last page.

For Tops in Pipe Wrench Performance...it's the Genuine RIDGID

If this Housing ever Breaks or Distorts we will replace it Free
RIDGID
HEAVY
Every RIDGID Wrench Work-TESTED at the factory

...with the guaranteed trouble-free housing!

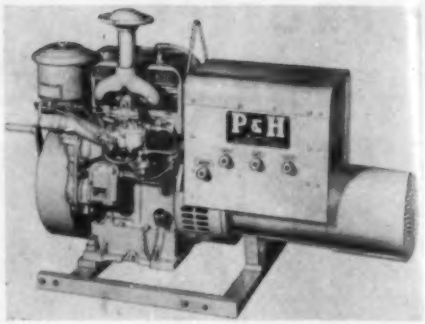
Only the RIDGID has a world-wide rep as the finest pipe wrench made. Only RIDGID has earned and maintains this rep by building toughness and smart performance into these overwhelmingly popular wrenches, checking them part by part and *hard work testing every last one* before shipment. When you buy a RIDGID, you know the housing won't break, the jaws won't slip or lock, the adjusting nut spins easily to all sizes, 6" to 60". Always most for your money—ask your Supply House.

Have you tried the new RIDGID Spud Wrench?

Deep narrow jaws for close work—break-proof housing — famous RIDGID jaw suspension — comfort-grip I-beam handle. Ask your Supply House.

THE RIDGE TOOL COMPANY, ELYRIA, OHIO, U. S. A.

RIDGID
Work-Saver Pipe Tools

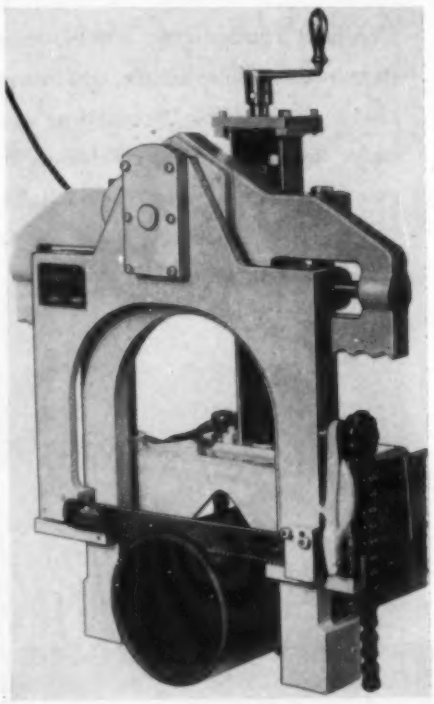


Light Weight Welder

Volume production of a new gasoline engine-driven arc welder has been announced by Harnischfeger Corporation. Completely new in design, the model WN-150 combines extremely small, compact size with generous output.

Power is supplied by two-cylinder, air-cooled gasoline engine which is close coupled to the P&H welding generator. Control has been simplified by the use of plug-in stations and by a variable-speed engine which covers the full heat range. Weighing only 425 pounds, this new welder has a capacity of 20 to 200 amperes. It is available with a handy two-wheel mounting.

For more data circle **No. E3** on Readers' Service Card, last page this issue.



Portable Power Saw

An entirely new type portable power saw for on-the-job cutting of two-inch to eight-inch cast iron and steel pipe as well as bar stock and beams has been announced by The E. H. Wachs Company. This new guillotine saw weighs only 120 pounds and comes equipped with a chain type pipe vise. It may be powered with either air or electric motors.

For more data circle **No. E4** on Readers' Service Card, last page this issue.

A JOB WELL DONE

Throughout every phase of pipeline construction, Houston Contracting Co. concentrates its skill and experience toward the completion of a job that meets the highest standards.

HOUSTON CONTRACTING COMPANY LTD.

General Partners:
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STANDARD OF THE INDUSTRY . . .
for cutting steel or cast iron pipe . . .

THE

ALSTON *Rachet* PIPE CUTTER

There's none better for SPEED, SAFETY, POWER, ACCURACY and ECONOMY. It eliminates dangerous sparks . . . broken cutters; rollers hold pipe taut after cutting. It's easy on and off pipe . . . will cut 10" pipe in 12 min. Patented roller guides. Rachet makes it easy to work in close places.

A size for every requirement . . . write for details, literature and prices.

ALSTON MANUFACTURING COMPANY

P. O. Box 707 **Phone 226**

LIVINGSTON, TEXAS

DIFFERENTIAL PRESSURE CONTROLS FOR LOW PRESSURES

MERCURY SWITCH EQUIPPED

FOR AIR OR GAS (INCHES OR FRACTION OF INCHES OF WATER)

TO OPEN OR CLOSE AN ELECTRICAL CIRCUIT ACCORDING TO A MINUTE CHANGE IN THE DIFFERENCE BETWEEN TWO PRESSURES OR VACUUMS

Mercoid Type PPQ Diaphragm Differential Pressure Controls operate from minute changes (.03" water) in the difference between two pressures.

Ranges to cover most applications (inches of water) 6" vacuum to 6" pressure, and 30" vacuum to 30" pressure. Available for various circuit arrangements.

Electrical Capacity—0.3Amp. at 115V., A.C. or 0.15 Amp., at 230V., D.C. Can be furnished in explosion-proof or weather-proof cases.

WRITE FOR BULLETIN CA-3P

THE MERCOID CORPORATION

4201 BELMONT AVE., CHICAGO 41, ILLINOIS, U.S.A.

For more data on advertised products, use Readers' Service Cards, last page.

New Catalogs and Equipment Literature

Catalog

The complete line of International Industrial Power products, 73 in all, is described in a new 48-page catalog just published by the International Harvester Company.

Technical data has been streamlined, yet provides abundant descriptive material on each piece of equipment in the entire line.

First of the eight sections in the catalog describes the seven International crawler tractors. This is followed by descriptive information on the Intornational 2T-75 and 2T-55 rubber-tired tractors with scrapers and the 2S-75 bottom dump wagon.

Allied equipment or attachments to International crawler tractors, such as Drott skid-shovels and Superior sidebooms are featured in the fifth section and cable control units and International wheel tractors for industrial use are presented on the pages forming the next two sections of the catalog.

Final portion covers the 18 models of International diesel, gasoline and gas power units.

To get a copy, circle **No. E5** on Readers' Service Card, last page this issue.

Industrial Rubber Catalog

Raybestos-Manhattan, Inc. announces the publication of an entirely new edition of its catalog of rubber products for industry.

The catalog covers V-belts, transmission belts, conveyor belts, all types of hose, molded products and outlines such new R/M products as the Poly-V Drive. Other new features and products highlighted are R/M Super-Power V-Belts, the "XDC" Conveyor Belt Cover, and the Hydro-Lock Rubber Pipe Flange.

The catalog 25-C is well illustrated with product and installation photos and its condensed copy is organized for the quickest possible reference.

To get a copy, circle **No. E6** on Readers' Service Card, last page this issue.

Chain Drive Catalog

A revised 16-page, profusely illustrated catalog including new and expanded data on capacity ratings of Morse Hy-Vo high speed, heavy-duty chain drives is now available from Morse Chain Company.

Operating principles and test data are included for drives that will carry up to 190-horsepower per inch of chain width at continuous chain speeds up to 6,000 feet per minute.

Specifications and capacity curves are included for standard ¾, 1, 1¼, 1½ and 2-inch pitch chain from 2 to 12 inches wide. Installation and lubrication recommendations are also included in the catalog.

To get a copy, circle **No. E7** on Readers' Service Card, last page this issue.

Control Catalog

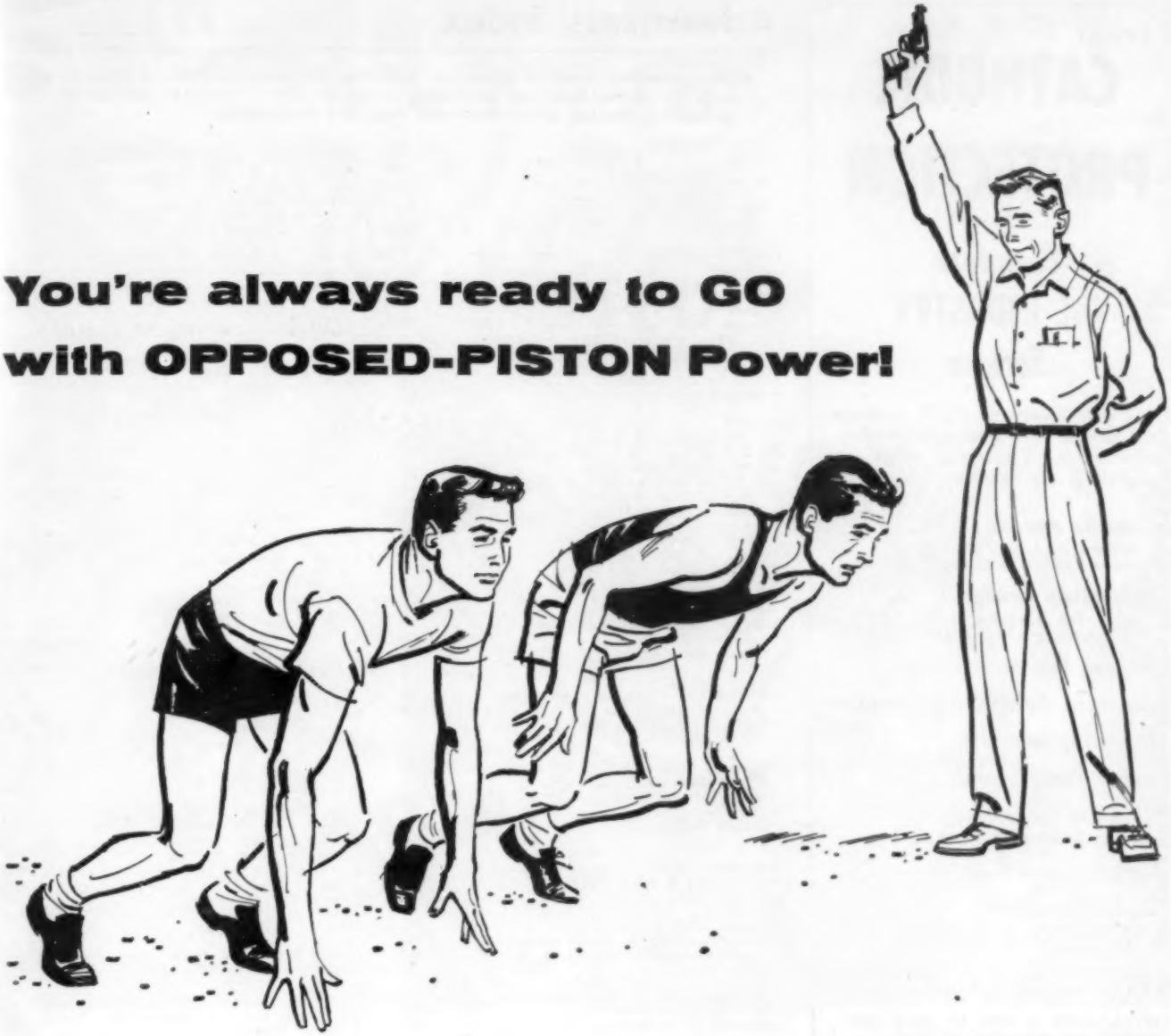
A new control catalog and manual has been released by Barksdale Valve Company. This manual contains important general information such as a detailed description and illustration of the Shear-Seal principle and its application in manual and solenoid valves.

Pressure switch selection, although seemingly complex, has been put into understandable terms in a selection chart based on users' requirements. The data in this book are indispensible to any engineer concerned with hydraulic or pneumatic control.

To get a copy, circle **No. E8** on Readers' Service Card, last page this issue.

ARCCO
NOW SPECIFIC GRAVITY RECORDING OF LIQUIDS AT ANY DISTANCE
RECORDING TRANSMITTER
Accurate long-distance transmission of specific gravity recordings is no longer a problem with the new Arcco-Anubis Metameter Recording and Transmitting Liquid Gravitometer. This instrument combines the mechanism of the standard Arcco Liquid Gravitometer with a metameter telemeter transmission system which records and transmits the specific gravity record to control room or other remote location. The interconnecting line may be any two-wire electrical circuit or its equivalent: private wires, telephone circuits, carrier current channels, or radio (VHF or UHF).
The range of the standard instrument is .15 or larger, but instruments with ranges of .10 or .05 can be supplied. Specific gravity charts are available for many gravity ranges, and special degree A.P.I. charts can be furnished at slight additional cost. Request Bulletin No. 111-R2B for complete details.
RECORDING RECEIVER
AMERICAN RECORDING CHART CO.
3113 E. 11th St. • Los Angeles 23, Calif.
Send For Bulletin No. 111-R2B

You're always ready to GO with OPPOSED-PISTON Power!

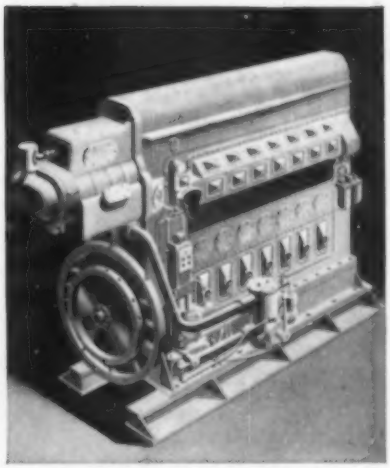


Take it either way . . . for fast starts or high availability . . . the Fairbanks-Morse Model 38F 90 diesel can't be beat for pipe line pumping. Whether you pump with diesel power 365 days of the year, or only during emergencies, no other engine can approach the dependability, maintenance economy and compactness of its Opposed-Piston design.

The Model 38F has minimum rotating masses, perfectly balanced . . . it can be brought up to full speed and placed on the line in less than 15 seconds. And 40% fewer moving parts also mean there are 40% fewer reasons for this engine to break down. Consequently, availability is higher . . . maintenance costs exceptionally low.

Compactness is another distinction of Opposed-Piston design . . . here is an engine that's 20% smaller and lighter than any other engine in its horsepower range . . . a big point to consider when pump sites are remote and building costs are high.

Other O-P advantages are three-way fuel options . . . diesel, dual-fuel or spark ignited gas . . . wear-free aluminum bearings, and maximum interchangeability of parts. Call your nearby Fairbanks-Morse Diesel Oil Field Expert, or write to Fairbanks, Morse & Co., Chicago 5, Illinois.



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OIL FIELD EQUIPMENT • PUMPS • SCALES • ELECTRIC MOTORS • GENERATORS • LIGHT PLANTS • DIESEL, DUAL FUEL & GASOLINE ENGINES • MAGNETOS • DIESEL LOCOMOTIVES

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Advertisers' Index

• Dot preceding name of advertiser indicates that detailed data on products and services of the firm will be found in current 20th (1953-54) edition of The Composite Catalog of Oil Field and Pipe Line Equipment.

A

Aero Service Corp. 17
Aerofin Corp. 12
• The Aldrich Pump Co. 10
Allen Cathodic Protection Co. 136a
• Allis-Chalmers Manufacturing Co. 115
Alston Manufacturing Co. 133b
American Bosch Division
American Bosch Arma Corp. 89
• American Recording Chart Co. 134
• American Sand-Banum Co. 104b
American Telephone & Telegraph Co. 32

B

The J. B. Beaird Co. 71
The Bovaird Supply Co. 31
• Bucyrus-Erie Co. 99

C

E. L. Caldwell & Sons 104a
• Catawissa Valve & Fittings 100
Caterpillar Tractor Co. 9
The City National Bank of Houston 30
The Cleveland Trencher Co. 112
Colorado Fuel & Iron Corp. 11
• Continental Motors Corp. 57
The Continental Supply Co. 14-15
• Fred E. Cooper, Inc. 125
• Crane Company 8

D

DeLong Corp. 108
• Detroit Diesel Engine Division
General Motors Corp. 119
Dowell Incorporated 24

E

The Electric Controller & Mfg. Co. 34
• Emsco Manufacturing Co. 107
Enterprise Engine & Machinery Co. 101

F

• Fairbanks, Morse & Co. 135
First National Bank in Dallas 69
Fleet-Line Co. 124c
• The Fluor Corp. 18
France Packing Co. 102

G

• Gardner-Denver Company 121
• Gaso Pump & Burner Mfg. Co. 138
• General Motors Corp. 119
• H. P. Gott Manufacturing Co. 102
• Graver Tank & Mfg. Co. 95
Greenhead Sling & Supply Co. 106b
Gunite Concrete & Construction Co. 124b

H

Hammond Iron Works 25
Houston Contracting Co. 133a
Humble Oil & Refining Co. 116

J

• Jet-Lube, Inc. ..... 98a and 126a
• Joy Manufacturing Co. 29

K

Kaiser Steel Corp. 38
• Kinzbach Tool Co. 122

L

Ladish Company 36-37
• LeBus Rotary Tool Works, Inc. 90
• Lufkin Foundry & Machine Co. 65

M

The Mack Iron Works Co. 126b
Mack Trucks, Inc. 85
• Marine Products Co. 98a
Mayes Bros. Inc. 118a
• McEvoy Company 97
• The Mercoid Corp. 133c
• Mixing Equipment Co. 127

N

National Bank of Commerce 23
• National Tank Co. 123
National Tube Division
United States Steel Corp. 26-27
• W. C. Norris, Manufacturer, Inc. 93

O

• Oil Center Tool Co. 117
• Oil Well Supply Division
United States Steel Corp. 5
• Otis Pressure Control, Inc. 6

P

• Pelican Supply Co. 136b
Petroleum Electric Power Assoc. 113
Pittsburgh Coke & Chemical Co. 21
H. C. Price Co. 109

R

Read Standard Corp. 129
• Republic Steel Corp. ..... 7 and 77
The Ridge Tool Co. 132
Roach Equipment Co. 106c
Rochester Manufacturing Co. 118b
• Rockwell Manufacturing Co. 61

S

Sealol Corp. 114
Second National Bank of Houston 91
Shand & Jurs Co. 20
• A. O. Smith Corp. 137
Southern Engine & Pump Co. 59
• Southern Mill & Manufacturing Co. 92
Standard Oil Company of California 35
Standard Supply & Hardware Co. 19
Station Construction Co. 106a
• Steel Forgings, Inc. 124a

T

Tennessee Gas Transmission Co. 81
Texas Employers Insurance Assoc. 72
• Thornhill-Craver Co. 13
Tracerlab Inc. 131b
• Tretolite Co. 16
• Tube-Kote, Inc. 88
Tube-Turns, Inc. 2

U

• United States Steel Corp. 5, 26-27
United States Steel Export Co. 26-27

V

The Vapor Recovery Systems Co. 128
J. H. H. Voss Co. 126c

W

• W-K-M Manufacturing Co. 33
Wagner Electric Corp. 28
Walworth Company 39
• Waukesha Motor Co. 22
The Whitlock Manufacturing Co. 131a
• Wickwire Spencer Steel Division
The Colorado Fuel & Iron Corp. 11
• T. D. Williamson, Inc. 120
• Wisconsin Motor Corp. 94
• Worthington Corp. 86-87

Y

The Youngstown Sheet & Tube Co. 103

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No change except the corporate name. We still have the same ownership, same management, same address, same telephone, and use the same 45 years of experience to render the same service under the same trade name—"PELCO."

PELICAN SUPPLY CO. INC.

P. O. Drawer 1108 Shreveport (84), La.
SEE YOUR NEAREST SUPPLY HOUSE

PIPE LINE PROGRESS

Magnolia Pipe Line Company builds new 20-inch crude line with A. O. SMITH TEXAS-MADE LINE PIPE

To supply 120,000 barrels daily to its Beaumont refinery, Magnolia Pipe Line Company of Dallas is building a new 208-mile crude oil pipe line from Corsicana. The line runs directly between there and Beaumont, crossing the Trinity River ten miles south of Oakwood, and passes near the towns of Crockett, Livingston and Sour Lake.

At Corsicana, oil from East Texas, Oklahoma, West Texas and New Mexico will be pumped into the new line. Ultimately, capacity of the line can be increased to 165,000 barrels per day with new pumping equipment.

All the line pipe for this new line is from the Houston mills of A. O. Smith and Sheffield Steel . . . 20-inch welded steel pipe that's accurate as to size, roundness and end-to-end matchup. We are proud to have been able to supply Magnolia Pipe Line Company Texas-made pipe for this all Texas line.

A. O. Smith Line Pipe is available in a complete range of sizes and wall thicknesses, from 8⅝-in. to 36-in. diameters.

The A.O. Smith Casing Mill is operating at capacity to supply vitally needed casing for the Oil and Gas Industry.

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International Division: Milwaukee 1

PIPE LINE INDUSTRY

CONSTRUCTION
OPERATIONS
MAINTENANCE

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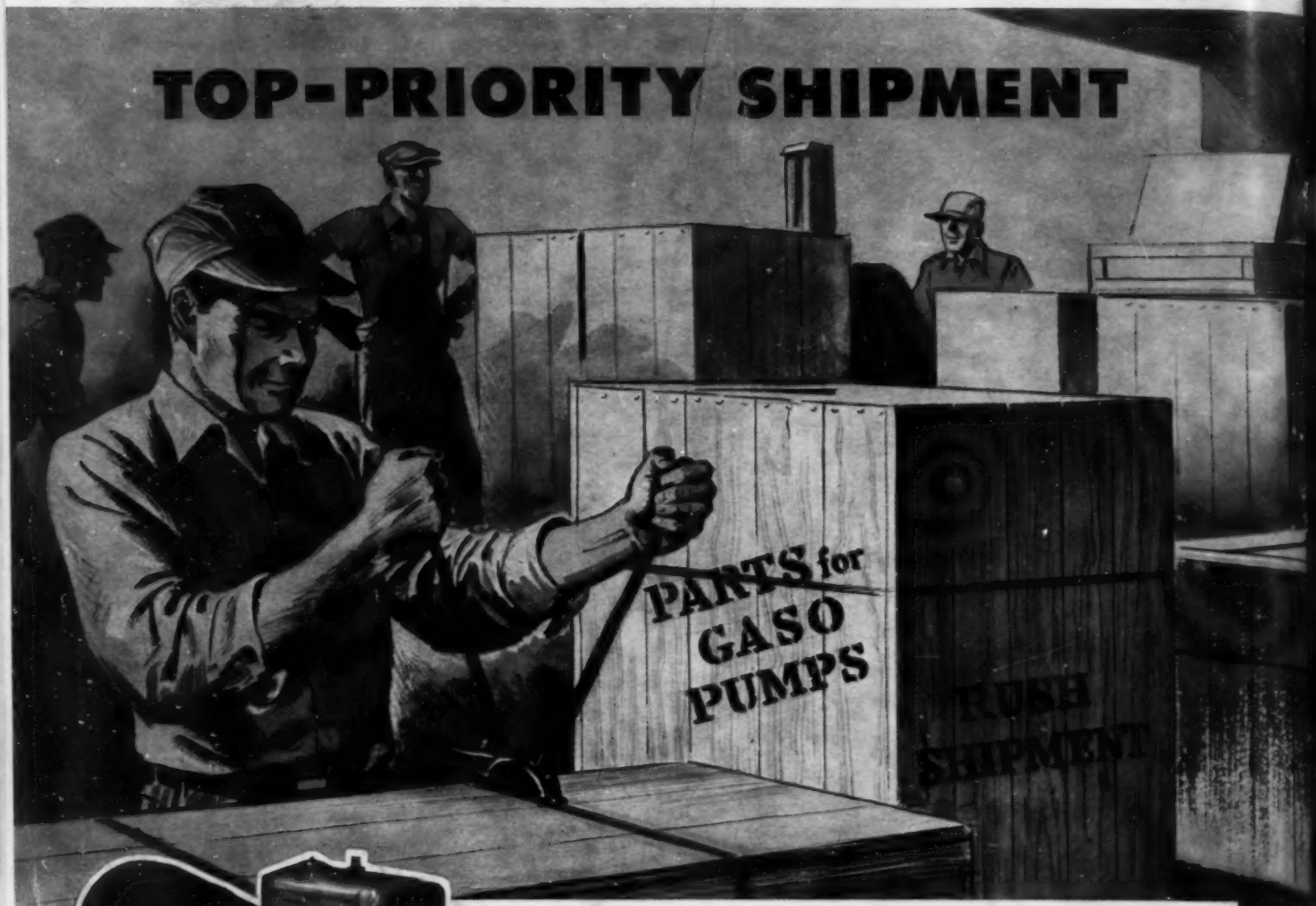

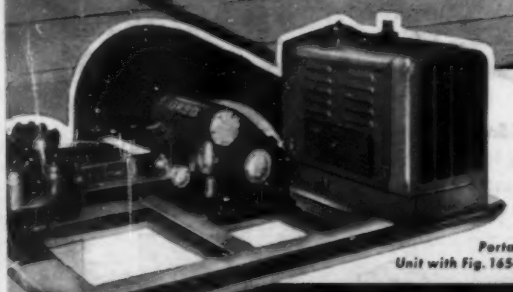

Portable Pumping Unit with Fig. 1654 Gaso Pump

The sturdiest pump may eventually need a replacement part, the strongest pump suffer accidental damage. In the Gaso plant, this situation is an emergency that calls for same-day shipment of parts, via fastest possible route from diligently maintained stocks. Cutting down-time to the bone is another example of interest that extends throughout the long, long life of Gaso Pumps.

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Long Beach, Calif. • Bakersfield, Calif.
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NORTEX ENGINE & EQUIPMENT CO., Wichita Falls, Texas
LUFKIN FOUNDRY & MACHINE CO., Casper, Wyoming

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for every oil industry need